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# Current Science

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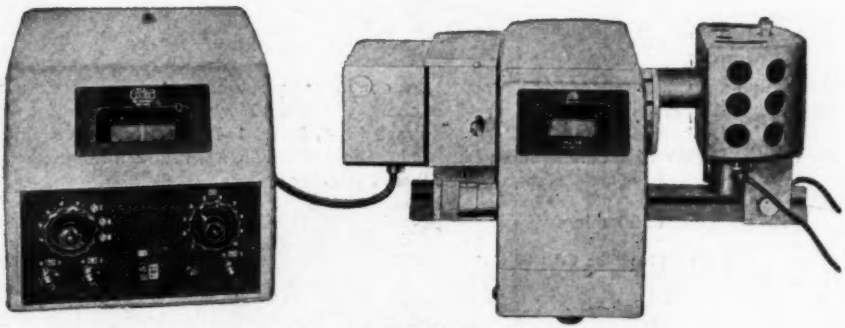

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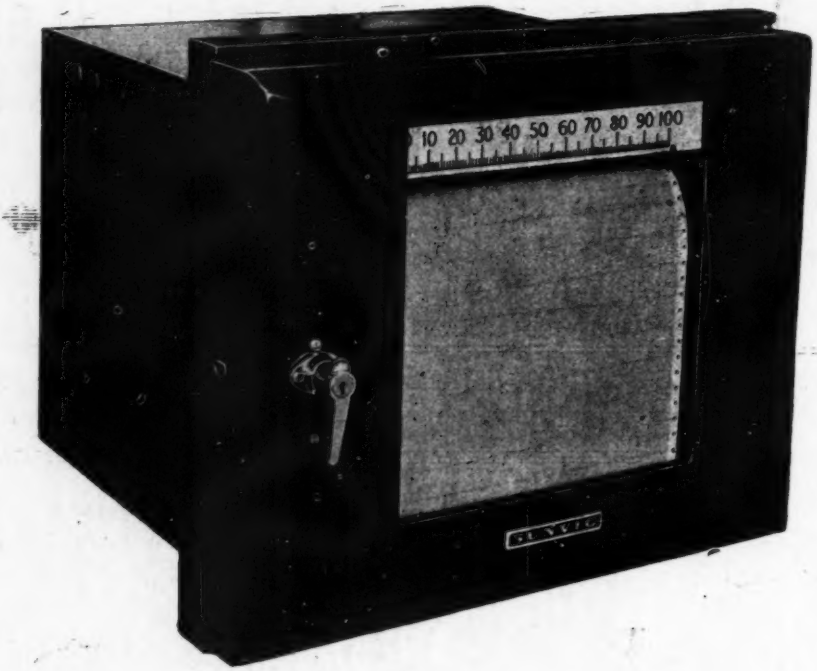


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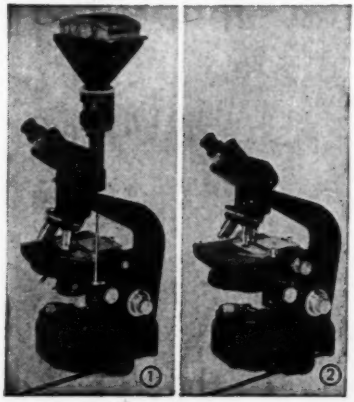

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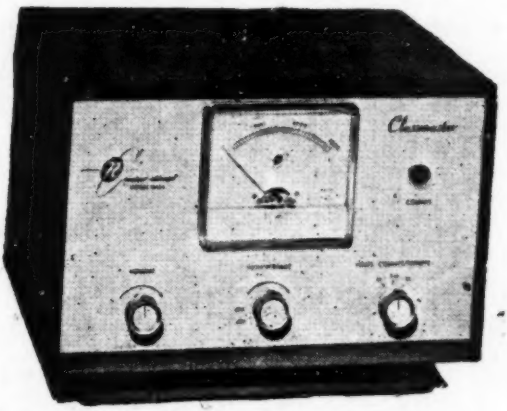

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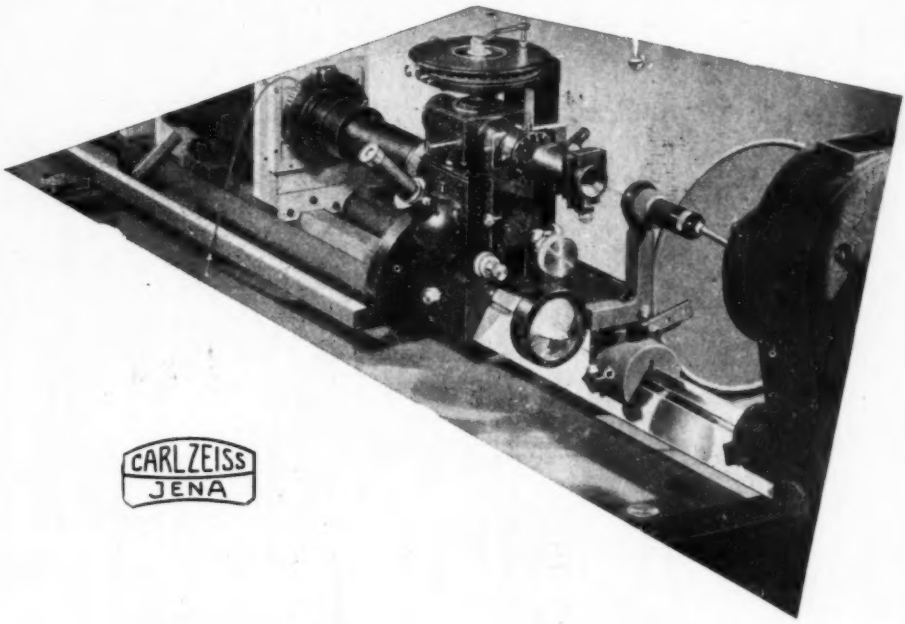


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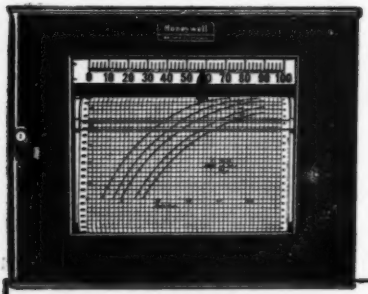

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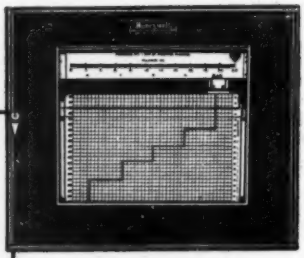

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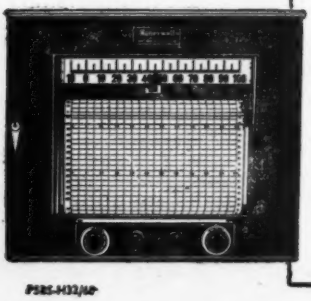

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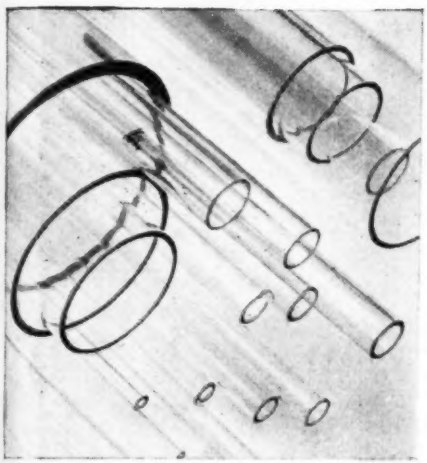

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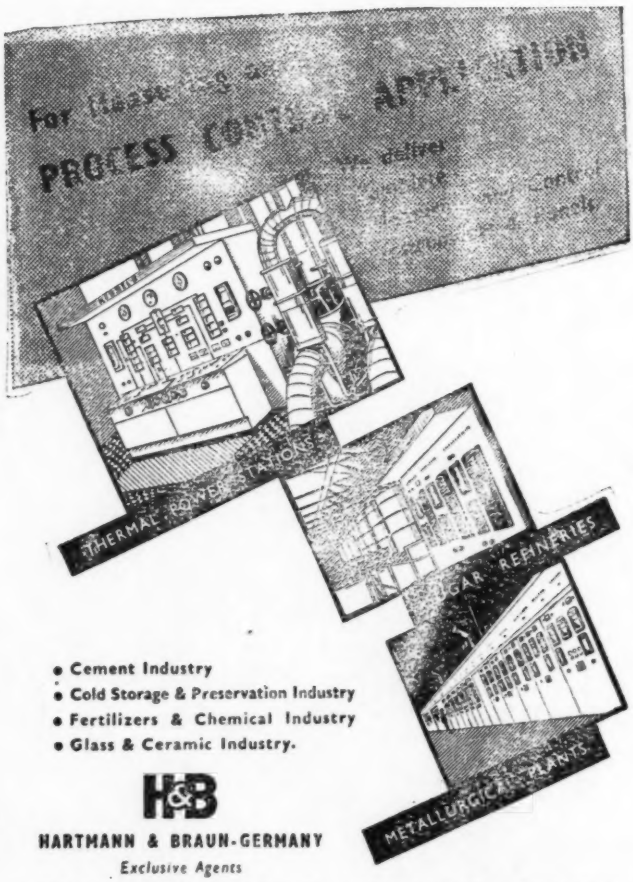


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# Current Science

Vol. XXIX] APRIL 1960 [No. 4


## CONTENTS


| | PAGE |
|---|---|
| *International Oceanographic Expedition to the Indian Ocean*—M. S. KRISHNAN .. | 119 |
| *Medical Cyclotron for Studying Lung Function* .. .. .. .. | 121 |
| *Model Seismology*—M. HAYAKAWA .. .. .. .. .. .. | 122 |
| *Ionization Induced by Artificial Earth Satellites* .. .. .. .. | 123 |
| *Plant Virus Diseases in Denmark—Their Incidence and Control.*—H. RØNDE KRISTENSEN | 124 |
| *Measurement of Soil Humidity by Radioactive Methods* .. .. .. | 127 |


### *Letters to the Editor*


| | |
|---|---|
| *A Study on the Complex Formation between Cerous Nitrate and Potassium Salicylate*—A. K. BHATTACHARYA AND M. C. SAXENA .. .. .. | 128 |
| *Spectrophotometric Investigation on Copper Murexide Complex*—R. K. CHATURVEDI .. .. .. | 128 |
| *The Near Ultraviolet Absorption Spectra of Fluoroxylenes*—M. R. PADHYE AND T. S. VARADARAJAN .. .. | 129 |
| *Sulphur Dioxide and Piperidine Complexes*—MISS K. SHARADA AND A. R. VASUDEVA MURTHY .. .. .. | 130 |
| *Chemical Investigation of 'Oos' Natural Deposits Near Kapadvanj*—J. P. TRIVEDI AND N. M. SHAH .. .. .. | 131 |
| *Constitution of Mangiferin*—J. D. RAMANATHAN AND T. R. SESHADRI .. .. | 131 |
| *Paper Chromatography of Antioxidants: A Simple Method of Identification and Separation*—B. R. ROY, S. N. MITRA AND P. N. SEN GUPTA .. .. | 132 |
| *Oxalate Contents of Leafy Vegetables*—T. S. ANANTHA SAMY, V. N. KAMAT AND H. G. PANDYA .. .. .. | 133 |
| *Possibility of Economising Irrigation Water by Using Biological Indicators*—O. P. GAUTAM, N. G. DASTANE AND AJIT SINGH .. .. .. | 134 |
| *Interaction of Chromic Ions with Amino-Acids: Spectrophotometric Studies of Chromium III Complexes of Lysine, Leucine and Aspartic Acid*—A. AZIZ KHAN AND WAHID U. MALIK .. .. | 135 |
| *Metallic Complexes of Embelin*—CH. BHEEMASANKARA RAO AND V. VENKATESWARLU .. .. .. | 136 |
| *Isolation of Hypoglycemic Principles in the Roots of* Casearia esculenta *Roxb.*—N. K. BASU AND K. D. CHOUDHURY | 136 |
| *A New Technique for Preserving Prawn Larvae*—M. K. THAKUR .. .. | 138 |
| *Cytology of Male Sterile* Crotalaria striata *D.C.*—C. KEMPANNA .. | 138 |
| *Turbidimetric Chloride Determination*—K. N. SYNGHAL .. .. .. | 139 |
| *Chromosome Number and Sex Mechanism in Sixteen Species of Indian Coleoptera*—UMA AGARWAL .. .. .. | 140 |
| *Response to Photoperiods of* Oryza *Species*—W. T. BUTANY AND S. SAMPATH .. | 141 |
| *Behaviour of the Black Bean Aphis in Selecting its Host-Plants*—MUHAMMAD AKHTAR ALIKHAN .. .. .. | 142 |
| *Condensation of Epichlorohydrin with Aromatic Amines*—J. R. MERCHANT, A. S. U. CHOUGHULEY AND KUM D. D. VAGHANI .. .. .. | 142 |
| *Note on a New Species of* Archegosaurus *from the Lower Gondwanas of Risin Spur (Kashmir)*—A. P. TEWARI .. | 144 |
| *Some New Plant Fossils from Upper Gondwanas of Krishna Dist., Andhra Pradesh*—B. B. G. SARMA .. .. | 145 |
| *Protopectinase Enzyme Secretion by* Penicillium expansum *Link in the Infected Fruits*—S. C. GUPTA .. .. | 146 |
| *Rapid Chromatin Staining of* Coffea *Sp. with Basic Fuchsin*—S. VISHVESHWARA | 146 |
| *A New Species of* Colletotrichum *from an Economic Host*—S. T. TILAK .. .. | 147 |
| *An Investigation on the Reaction between Vanadyl Sulphate and Malonic Acid*—P. K. BHATTACHARYA AND S. N. BANERJI | 147 |
| Masoniella indica *Sp. Nov.*—M. A. SALAM AND P. RAMARAO .. .. .. | 148 |
| Meliola albizziæ *Hansford and Deighton from Assam*—V. AGNIHOTHRUDU .. | 149 |
| *Reviews* .. .. .. | 150 |
| *Science Notes and News* .. .. | 157 |

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# INTERNATIONAL OCEANOGRAPHIC EXPEDITION TO THE INDIAN OCEAN

VERY little publicity seems to have been given in this country to the fact that an International Oceanographic Expedition to the Indian Ocean is being actively planned at present by the Special Committee for Oceanographic Research (SCOR) under the auspices of the International Council of Scientific Unions (ICSU) with the co-operation of many of the well-known Oceanographic Institutes of the world (*Curr. Sci.*, 1959, 28, 398). The expedition is expected to go into action in 1960-61 and continue for about three years, during which the whole of this ocean will be fairly well covered. At least a dozen research ships equipped for Oceanography from U.S.A., U.K., U.S.S.R., France, Japan, South Africa, Australia, Israel and Indonesia will take part in this work. The Indian Navy vessel which is engaged in Physical Oceanography studies in Indian waters will co-operate while other countries like West Germany, Holland, Norway, Denmark are also expected to come in for part of the time.

The Indian Ocean occupies very nearly 75 million square kilometres and its mean depth is 3,900 metres. Its area is about one-seventh of the total area of the globe and one-fifth that of all oceans. The continental shelf around this ocean is estimated to cover about 4-5% of its area but nearly 82% of its area is over 3,000 metres deep. It is surrounded by land masses on all sides except in the south-west and south-east where it connects with the Atlantic and Pacific Oceans respectively through broad openings to the south of South Africa and of Australia. To its west and north are Africa and South Asia with large populations which are in a low stage of economic development. This expedition would be of great importance to these countries because of the possibilities of economic development of the food and other resources of the ocean area. The Indian Ocean happens to be the least explored of all the oceans. A few patches of it have been cursorily investigated at various times but there are very large areas where no observations of any character are available at all. It is stated that no biological sampling has been done in half the area of this ocean and that physical data on depth, temperature, currents, etc., available for this ocean are numerically less than 1/300 of those available for the Atlantic.

So far as India is concerned, some work has been done in the years following 1881, when an Oceanographic vessel called *H.M.I.S. INVESTIGATOR* was put into commission. It was a wooden vessel of 580 tons weight and it is stated that some of the gear of the Challenger expedition was used on this ship. A fair amount of useful information on the physical and biological aspects of the areas immediately surrounding India was collected by this ship and a book entitled "A Naturalist in the Indian Seas" was published by Alcock in 1888. Many years later, R. B. Seymour Sewell became the surgeon naturalist on board the ship and he made a number of studies in Indian waters which appeared in a series of monographs published by the Asiatic Society of Bengal, Calcutta, between years 1925 and 1938.

In recent years, a modern fisheries research station has been established at Mandapam on the east coast of Madras under the auspices of the Central Government. This institution has several branches on the Indian coasts and is conducting researches on fisheries and allied problems. Oceanographic studies were started in the Andhra University in 1952 under the guidance of Dr. E. C. La Fond of the Scripps Institution of Oceanography and attention has been directed to physical, geological and biological aspects of Oceanography. A modern marine biological station has been started at Porto Novo under the auspices of the Annamalai University, while the Travancore University has secured a small ship with which it is conducting Oceanographic researches near about Travancore. There is, in addition, a Department of Oceanography in the Bombay University which is also active in this line.

During the last 30 years or so, several Oceanographic ships have taken part in investigating parts of the Indian Ocean. *Dana I* and *II* (1920-22 and 1928-30), *Snellius* (1930-31); *Mahabiss* (John Murray Expedition to the Red Sea and Arabian Sea—1933-34); *Albatross* (1947-48), *Discovery* (1950) and more recently *Galathea* (1950-52). Because of the vastness of the area concerned, the amount of available information is scanty, sporadic and uneven.

The Indian Ocean is traversed by a mid-ocean ridge which starts from the Gulf of Aden and proceeds first in a south-easterly direction up to the Chagos Archipelago and then more or less southward to Keruguelen and Heard

Islands near Lat. 50° S. This ridge connects with the mid-Atlantic ridge through Crozet and Bouvet islands to the south of Africa and with the Albatross plateau and Easter Island ridge in the south-east Pacific through an arm extending between Antarctica and Australia. The mid-Indian Ocean ridge is similar to the mid-Atlantic ridge which is now known to be a continuous canism and shallow focus earthquakes all along its length. It may also show a deep rift along the crest line as does the mid-Atlantic ridge. It was recently reported by a Russian ship (in June 1957) that while crossing the Arabian Sea from Colombo to the Gulf of Aden, it observed millions of tons of dead fish floating in the sea, covering an area of at least 1,000 km.

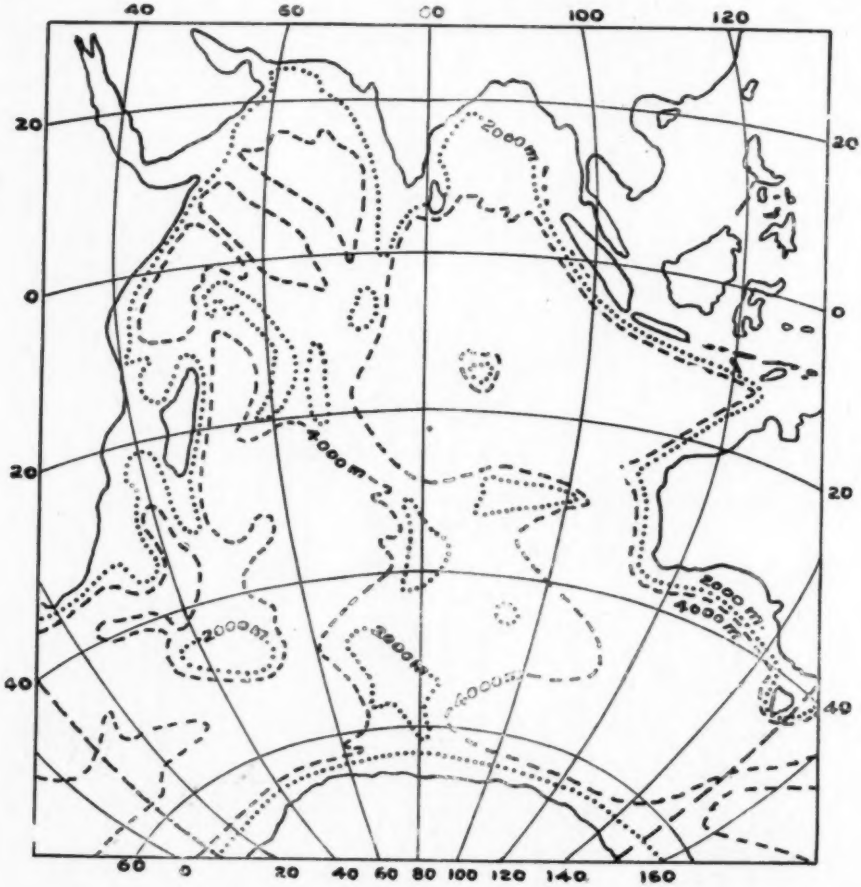


FIG. 1. The Indian Ocean (showing the 2,000 m. and 4,000 m. depth contours).

feature from near the North Pole right along the Atlantic more or less symmetrical between the land masses on either side. The mid-Indian ridge is, however, wider than the mid-Atlantic ridge and in general deeper from the sea surface. What little is known of it indicates that it is a large tension feature, connected at one end with the Red Sea rift, and marked by volby 200 km. Though the cause of this mortality is not known definitely, it may be suggested that it was due to extensive volcanic eruptions in the region of the mid-Indian ridge (this part being known as the Carlsberg ridge) at some depth below the sea-level, which might have poisoned the fish in very large areas of the ocean.

The International expedition will make systematic investigations over all parts of the Indian Ocean and its studies will include *physical oceanography* dealing with ocean currents, air currents, temperatures, salinity, upwelling and sinking of waters and their relationship to climate; *geology* including nature of ocean bottom sediments and rocks, submarine topography and its relationship to the features on the surrounding land masses; *biological aspects* such as the various groups of animals and plants characteristic of the different areas, their productivity in relation to physical conditions and currents and their usefulness for food and for other purposes; *geochemical aspects*, including the presence of various minor chemical constituents, Oxygen and Carbon dioxide contents, and their effect on sedimentation and marine life; *geophysical aspects* such as the gravity and magnetic fields, distribution of seismic and volcanic phenomena and the structure of the ocean basins in relation to the surrounding lands, and the nature of the oceanic crust. Ultimately all these studies will be utilised for building an integrated picture of the whole globe.

It is well known that, starting from the *geophysical year*, considerable work has been and is being done in the Antarctic continent. A great deal of fresh knowledge has been gathered which will be analysed and published in the near future. It is appropriate, therefore, that the Indian Ocean which forms a large part of world's surface should now receive attention. Provision is also being made in the Indian Ocean Project to obtain the co-operation of all the countries surrounding the Indian Ocean so that the nationals of these countries can be trained in oceanographic work to enable them to continue it in future. The materials to be collected during the expedition will be investigated in the vessels themselves as far as facilities permit, but the greater part will go to various laboratories for proper examination and report.

The preliminary estimate of cost of this Project is roughly $ 13 million to which an addition may have to be made for extra equipment and for any training programmes of local scientific personnel. Roughly half of this cost will be for scientific staff and the rest for operational expenses. The estimates have been made on the basis of a total coverage of 220,000 miles of traverse on the scale of planning adopted at present.

Several of the most experienced Oceanographers of the world will take part in this work and will train a number of young scientists. There is little doubt that this great International Project will lead to the achievement of highly useful and spectacular results, both scientific and economic. It is up to India and other underdeveloped countries around the Indian Ocean to take full advantage of this expedition by co-operating with it and by organising their own units for continuing the work effectively and efficiently.

M. S. KRISHNAN.

## MEDICAL CYCLOTRON FOR STUDYING LUNG FUNCTION

THE Medical Research Council's cyclotron at the Hammersmith Hospital, London, is devoted entirely to medical uses. This atom-smashing machine has made possible the use of radioactive oxygen for following lung function, both for basic physiological research as well as for diagnosis.

Oxygen-15, produced by deuteron (heavy hydrogen) bombardment of nitrogen in the cyclotron, has a half life of only two minutes and for this reason can only be used at the place of preparation. The patient is surrounded by counters which measure the gamma radiation given off and is then given a single breath of air containing a trace of $O_2^{15}$. The distribution of the air is then measured in the lungs while he holds his breath as well as the rate of clearance on subsequent breathing.

Variations between different regions of the lung can quickly be detected in this way and areas of the lung that are not functional can be recognized. From the rate of clearance of radioactivity valuable information about blood flow is obtained and quick reliable diagnoses can be made which would otherwise require lengthy and often painful investigation.

Moreover only the simplest manœuvres are expected of the patient and breath-holding is the only departure from physiological condition. This contrasts with the need for a local anæsthetic for the conventional method of bronchospirometry—the only way of obtaining comparable information.

While the short half life of oxygen-15 is an inconvenience in so far as it demands manufacture on the spot, it is a great advantage in that it makes repeated examinations possible, without harm or inconvenience to the patient.—*ISLO Newsletter.*

# MODEL SEISMOLOGY

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MODEL Seismology is a recently advanced technique in geophysics the value of which is being increasingly recognized in many seismological laboratories throughout the world.

In Japan there are many researchers (including the author) in this new branch of geophysics and the object of the present note is to give a brief outline of the method based on the work that is being done in Japan.

Although the underground geological structure is calculated by the data obtained from field seismic survey, sometimes we meet with difficulties in analysis which mean not only the mathematical labour involved but also the various difficulties regarding interpretations. In such a case, besides seismic wave velocity, amplitude attenuation and frequency changes owing to the shot to detectors distances are necessary. The seismic model experiment is one of the best ways of solving this question.

The application of ultrasonic pulses makes it possible to avoid the difficulties in procuring suitable model materials and in fabricating desirable configuration.

The transmitting and receiving equipments are of usual type in the studies of model seismology. A block diagram of the equipments is shown in Fig. 1. (I quote here mostly from

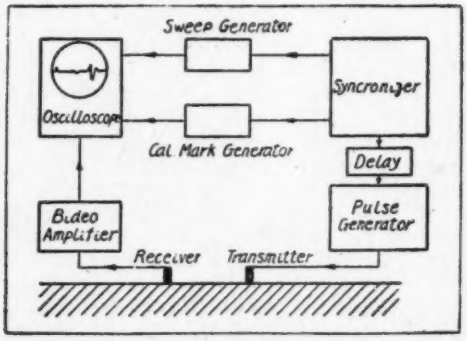



FIG. 1. Block diagram of apparatus

the result obtained by Prof. Y. Kato and Dr. A. Takagi, Tohoku University and Dr. S. Nagumo and others, Government Geological Survey of Japan.)

An electrical pulse of about 4 micro-seconds duration is applied to the transmitter of a small piezoelectric element. The form of pulse delivered by this transmitter is recorded as shown in Fig. 2. The record is obtained by the operation of contacting the receiver directly with the transmitter.

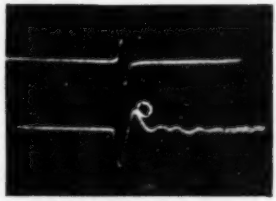
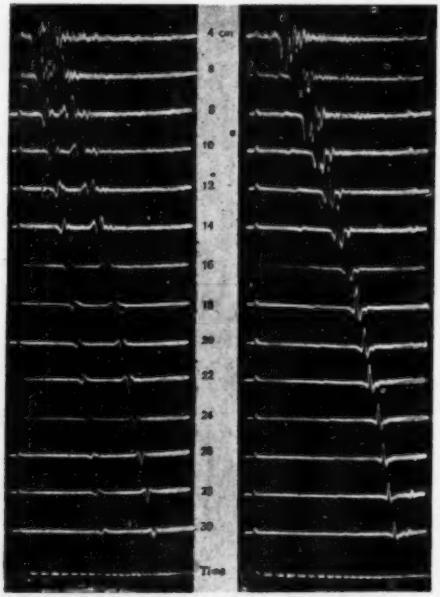



FIG. 2. A: Electrical Pulse; B: Pulse, obtained by the operation of contacting the receiver directly with transmitter.

The acoustical energy arriving at various points in the model is detected by a receiver similarly designed to the transmitter. Waves thus obtained are amplified and displayed on a cathode ray oscilloscope. The pulse repetition



Horizontal Component Vertical Component

FIG. 3. Typical model records for spreads from 4 cm. to 30 cm. on semi-infinite solid model (Bakelite plate).

rate is taken to be 200 per second. The pulse amplifiers have a good response within the frequency range from several tens Kc./sec. to about a few Mc./sec.

The transmitting transducer is a cylinder, made of barium titanate, whose thickness is 1 mm. and effective diameter 6 mm. The receiving transducer is a rectangular slice, also made of barium titanate whose dimension is $4 \times 2 \times 1$ in mm. unit.

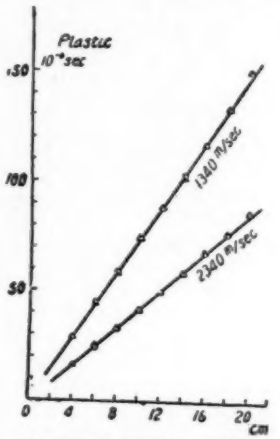



FIG. 4. Travel-time curve for semi-infinite model.

A plastic plate is used as a model for a semi-infinite solid. The measurements are carried out at each 2 cm. interval within the range of distance 30 cm. from the transmitter. An example will be seen in Fig. 3.

As shown in these two figures, two predominent phases are found. For the identification of these phases, travel-times of the initial motion of these phases are taken as shown in Fig. 4. The curve of travel-times of each phase are well expressed by a straight line crossing the ordinate at the origin. After examining the hodographs for the orbit of the pulses, obtained from the seismograms of two components, the first and second arrivals are ascertained as P and S waves, respectively.

We are now carrying on many models on two-layered earth, fault effect and others. These results will be published in the near future in Japan.

Finally, it may be added that this equipment is also utilized for the direct measurement of seismic wave velocity transmitted through rock samples.

## IONIZATION INDUCED BY ARTIFICIAL EARTH SATELLITES

ARTIFICIAL earth satellites at the times of their near approach encountering regions of high particle density or colliding with fast corpuscular streams, scatter the material into ionized clouds. These ionized clouds travelling earthwards eventually act as reflectors or back-scattering medium for radio waves and produce significant changes in the intensity of reception of radio signals.

In a recent issue of *Nature* (1960, 185, 520), J. D. Kraus *et al.* have reported the results of observations at the Radio Observatory, Columbus, Ohio, on the enhancements of monitored signals recorded at the times of near approach of Sputnik III. In these observations it was found convenient to monitor the WWV signals (20 Mc./s.) of the time service station of the National Bureau of Standards, Washington D. C., 330 miles from Columbus. Enhancements of signals were recorded between January 9 and February 7, 1959, on successive nights during the passes of Sputnik III (3-4 passes per night).

Analysis of the results shows that at each approach of the satellite there occurred three large enhancement peaks, *viz.*, (1) a precursor enhancement peak about 15 min. before near approach, (2) a peak at near approach and (3) a post-enhancement peak about 8 min. after near approach. It is significant that these times corresponded to the times the satellite was in the auroral zone. This suggests that the satellite encountering regions of high particle density in the auroral zone scattered material into ionized clouds or streams which travelling closer to Columbus affected the monitored signals causing many of the observed signal enhancements.

Radar reflection studies have also confirmed this hypothesis of induced ionization by earth satellites. It was observed that at the time radar signals were reflected, the signals from the Sputnik III transmitter, which had been very strong, dropped for a minute or so to a low level after which they became strong again. The conclusion may be drawn that the ionized clouds while they acted as reflectors for radar signals also acted as the absorbing medium for the satellite transmitter signal.

# PLANT VIRUS DISEASES IN DENMARK—THEIR INCIDENCE AND CONTROL

H. RØNDE KRISTENSEN

*FAO Consultant, Forest Research Laboratory, Bangalore*

IT would be useful to list the important plant virus diseases which have received attention in Denmark during the last 15 years. Amongst agricultural plants, sugar-beet yellow virus, potato leafroll virus, potato virus Y and potato virus X are the most important. In horticultural crops some of those attacking fruit trees and causing diseases known as flat limb, rubbery wood, apple mosaic, green crinkle, stony pit, plum lime pattern, cherry ringspot and many others are conspicuous, while in fruit bushes, virus diseases are specially to be found in black currant (reversion), in raspberry (various mosaic diseases) and in gooseberry (yellow veinbanding).

Amongst the vegetables, tomatoes specially suffer from widespread virus attacks—in most cases due to infection of tobacco mosaic virus. And as to the ornamental plants, it may be truly said that few species have completely escaped virus infection,—the most important virus diseases being those attacking chrysanthemums, carnations and dahlias.

Amongst forest plants the mountain ash, *Sorbus aucupaira*, is often infected with a virus causing a ringspot—mosaic pattern on the leaves. Also various species of poplar are frequently found to be virus infected.

Most of the research work and investigations concerning plant virus diseases in Denmark are carried out at or are being conducted from the State Plant Pathology Institute, which is situated in Lyngby, a suburb of Copenhagen.

This Institute has several departments devoted to fungus diseases, virus diseases and physiological diseases as well as pests. The Institute has also an advisory department which is working in very close co-operation with a large team of agricultural and horticultural advisers covering the whole country. As there is a very close co-operation between the advisory department and all the other departments of the institute, any new or apparently new virus diseases found, will immediately be handed over to the specialists in the field for further investigation.

The virus specialists try as far as possible to visit all the places, from where attacks of new virus diseases have been reported in order to get a first-hand impression right on the spot. With such elaborate organisation the virus workers have a good chance to come to know of any new virus diseases in so far these diseases manifest themselves with external symptoms.

## Work on Plant Viruses

The work done on plant viruses can be broadly grouped under the following heads: A. Diagnostic Work; B. Spread and Sources of Infection; C. Control Measures.

### A. Diagnostic Work

Control measures are naturally effective only with early and reliable diagnosis. By experience the virus worker may in some cases be able to identify some virus diseases on basis of visible symptoms, but as these symptoms are very much influenced by environmental factors and also, as disorders other than viral may produce virus-like symptoms, it is often very difficult to carry out a virus diagnosis based on symptoms only. This is of course especially evident when the infected plants show no symptoms at all (as in the case of latent infection). In many cases the virus workers therefore are compelled to have recourse to use special identification methods for diagnosis. The methods which have so far been adopted in a very extensive way are infection experiments, (indexing to indicator plants) and serological investigations.

#### 1. Infection Experiments

To find out whether a suspected plant is virus infected or not and if possible to identify the virus in question inoculum from the plant to be tested is transferred to one or more species of indicator plants (test plants), which are likely to react in a special way in case of virus infection.

The methods used for transferring the infectious agent from the source of infection to the test plants, depend on the kind of virus, suspected to be involved, but they are mostly mechanical sap transmission, insect transmission and transmission by grafting. Incidentally, the mode of virus transmission can also give some indication of the nature of the virus. Infection experiments are now being used on a very great scale in Denmark—not only for pure academic purposes, but also in order to select completely virus-free mother plants of several economically important crops (see under control measure).

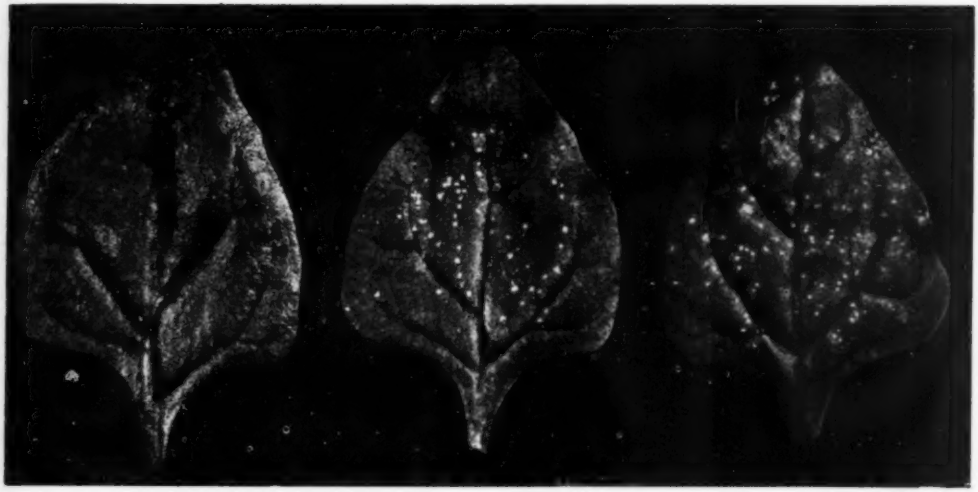


FIG. 1. Local lesions in *Tetragonia expansa* caused by Tobacco necrosis virus sap inoculation. Extreme left: uninoculated leaf.

### 2. Serological Investigations

During the last 8 years, serological methods have assumed growing importance in diagnosing plant viruses in Denmark, and antiserum against a number of different viruses have been produced. This has proved of special value to the potato farmers, as it is now possible to carry out routine testing for potato virus X and S on a very large scale with efficiency and accuracy.

The practical aspect of this work is so important that statutory provisions of the Ministry of Agriculture govern the supply of Danish seeds potato, Bintje, certified to be free of virus infection by serological tests. This practical application of a laboratory technique is a good example of Danish organisation wherein:

(1) The virologist produces the antiserum and devises the methods for its use; (2) The agricultural field research workers are trained in regular courses of instructions how to use the antiserum; (3) The actual tests are carried out at agricultural research stations. Check tests of samples are performed by the Government Plant Protection Service; (4) The growers of certified seed potatoes (Bintje) are using the tested material for further propagation under suitable conditions.

## B. Spread and Sources of Infection

When trying to work out any control measures against plant viruses, it is important to know about their modes of spread as well as about the sources of infection. With these objectives, numerous transmission experiments have been (and still are) carried out in Denmark. Besides the experimental transmissions which are directly performed by the virus workers, a number of trial plots have been laid out at various agricultural and horticultural research stations all over the country to investigate the spontaneous spread of the more important virus diseases such as potato leafroll virus, potato virus Y, sugar-beet yellow virus, raspberry mosaic virus, etc.

Counts of the most important virus vector in Denmark—the green peach aphid, *Myzus persicæ*—have also been performed for a number of years in order to gain information about the population of aphids occurring in various years, various periods of the year and in different parts of the country.

Sources of infection are of course the infected plants, not only those showing distinct virus symptoms but also plants with latent infection. To tackle any virus disease it is important to know which plants can act as virus sources, in other words, which plants are susceptible to the virus in question.

Rather large-scale experiments have therefore been performed to find out the resistance susceptibility of a comprehensive range of likely host plants for some important viruses. Large-scale experiments are comparatively easy to perform, when working on sap transmissible

viruses—the major items of cost being insect-proof greenhouses, where the plants can be grown under controlled conditions.

When working on viruses which can only be transmitted by insects or by grafting, matters become somewhat more difficult. In earlier days all the plants used in the insect transmission tests, had to be placed in cages, that often caused a poor growth of the plants and further these cages were rather uneasy to handle and fairly expensive and space consuming. This has now been improved.

Instead of placing the plants in cages, small cages are placed wherever wanted on the plant (*see* Fig. 2). By using this type of cages, it is

FIG. 2. Insect cage for virus transmission. Transmission by aphids of sugar-beet yellow.

possible to carry out aphid transmission tests in great numbers and to perform hostplant investigations with aphid-borne viruses in an easy way.

Turning now to the viruses, which are—as far as we know only transmissible by grafting, rather reliable experiments may be performed outdoors, but naturally insect-proof greenhouses would also be preferable.

### C. Control Measures

(I) *Sugar-beet yellow virus,* which is one of the most economically important viruses in Denmark, is transmitted by the aphid, *Myzus persicæ,* which in mild winters is able to survive in the sugar-beet clamps. From these clamps infective aphids during May-June migrate to the young sugar-beet plants in the field with the consequence that these plants in turn will be infected (early infection can cause up to 50% reduction in yield).

Extensive insecticide-trials have shown, that use of systemic insecticides, when the first aphids appear in the field reduces and delays the infection very much. It is however of the greatest importance to perform these sprayings at the right moments, and by collaboration between all interested parties, a spraying warning service has been established under the leadership of the Plant Pathology Institute. Based on very frequent reports from advisory officers all over the country the Institute issues the spray warning through papers and radio.

(II) *Potato viruses* are also of great importance, the most common viruses as mentioned earlier being potato leafroll virus, potato virus Y and potato virus X.

The first two are in most cases easily recognisable in the field and can therefore be removed by the inspections, which are carried out in the fields, where seed potatoes are grown. Virus X on the other hand is carried by many potato varieties without any external symptom and has to be recognised by serological tests. A very large number of such tests are carried out and it has thus been possible to select large quantities of virus-free seed potatoes (see under serological investigation).

### 3. Virus Diseases of Horticultural Plants

It is only in very recent years that the horticulturist has recognised that the technique by which many of his plants are propagated (vegetative propagation) is specially vulnerable to virus transmission. Indeed, it is rare to find virus-free stock of some important varieties of

FIG. 3. Slide agglutination test. On left sap from virus X-infected potato leaf mixed with virus-X antisera. On right, sap from healthy leaf similarly treated.

apple, raspberry, gooseberry, dahlia, chrysanthemum, carnation and narcissus.

Realising what the consequences of many of these virus diseases may well be, several countries have now taken steps to prevent further spread. In the following I shall try to give a brief account of the measures we have taken in Denmark.

In 1948 "The National Committee for the Propagation and Sanitary Inspection of Horticultural Plants" was established. This Committee collaborating closely with the State Institute of Plant Pathology and the Horticultural Research Stations, has now taken over the majority of all field inspections of horticultural plants in Denmark.

By carrying out inspection and roguing in nurseries (which operation is now compulsory in Denmark) it has been possible to eliminate a large proportion of plants severely affected by virus diseases, and consequently the general standard of health among plants offered for sale in Denmark has considerably improved.

However, as these field inspections are carried out on the basis of visible symptoms only, the risk of approving plants with latent virus infection is quite obvious, and therefore the National Committee is keen on selection and multiplication of virus-free material from many different plant species.

To insure that the selected motherplants are totally free from any known virus, it is necessary to carry out thorough investigations. These investigations can in certain cases—as earlier described—be performed by serological methods, but where fruit trees, fruit bushes and strawberries are concerned, serological methods up to now, have not proved effective. In testing these plants, indexing is used, mostly through grafting and budding on many different testplants.

In cases where it is impossible to find virus-free plants of certain valuable varieties it might be feasible to use heat treatments as a cure. As a rule a temperature of about 35° C. to 37° C. is used over varying lengths of time depending on the virus, the host plant and the time of year. In this way, it has been possible to inactivate Aspermy virus in chrysanthemum, mosaic virus in shallots and mild mosaic in raspberry. Attempts have also been made to combine heat treatment with tissue culture, but this work is still in the preliminary stage.

Apart from their scientific interest, plant viruses have a direct bearing on a very important world problem today, *viz.*, how to provide sufficient food for the rapidly growing populations. Increased food production can be achieved in many ways. One of the most obvious must be to reduce the heavy toll taken by pests and diseases among which the virus diseases take a high place. Therefore, every effort should be made to investigate these diseases as thoroughly as possible and apply the knowledge thus gained to step up our food production. This work calls both for national effort and international co-operation ; Denmark is trying to play its part. A measure of this is to be found in the next European conference on tree viruses meeting at Copenhagen in July 1960.

## MEASUREMENT OF SOIL HUMIDITY BY RADIOACTIVE METHODS

γ-radiation and neutron emission from radioactive nuclei afford methods of measuring the humidity of soils. The proportionate reduction in the intensity of a beam of γ-rays in traversing a material is a function of the thickness and the nature of the material traversed. By comparing the attenuation produced when γ-rays pass samples of dry and humid soils it is possible to calculate the water contents of the soil.

In the actual experiment a long hollow tube, which carries at its one end a Co-60 γ-ray source kept in a small lead container provided with a window, is driven obliquely into the soil. At the surface of the ground, directly above the Co-60 source, is placed a radiation counter which indicates the intensity of the γ-ray after it has traversed the soil thickness from source to ground level. This method allows measurement of soil humidity up to a depth of 50 cm.

The second method is based on neutron density measurements. It is known that fast moving neutrons, from a neutron source, passing through a moderator, such as water, collide with the hydrogen nuclei (in water), lose their high speed, come into thermal equilibrium with the ambient atoms, diffuse according to the laws of gaseous diffusion, and finally, are captured by nuclei of surrounding atoms.

The rate of fall of neutron density in the surrounding moderator will be a measure of the hydrogen (water) content. In the actual experiment a pellet of a mixture of polonium and beryllium is used as the neutron source. The source and the neutron counter are embedded in the soil to be studied. By a run of preliminary experiments on soil at different stages of dryness, a curve is drawn giving the relation between neutron density and soil humidity. This curve is used in further experiments on samples of soil.

Although the method is time-consuming, it has the advantage that it is independent of the soil composition, density, temperature, etc.—*WMO Bulletin January* 1960.

# LETTERS TO THE EDITOR

## A STUDY ON THE COMPLEX FORMATION BETWEEN CEROUS NITRATE AND POTASSIUM SALICYLATE

THE hydroxy-carboxylic acids are known to form complexes with a number of metals. Recently Varma and Mehrotra[1] have reported the results of physicochemical study on the complexes formed by beryllium ions with salicylic acid. The formation of cerous salicylate from cerous chloride and sodium salicylate has also been reported.[2] However, no detailed physicochemical investigation has been so far carried out in the case of the above complex. The present note reports investigation of the complex formed between cerous nitrate and potassium salicylate, as indicated by the electrical conductance and pH measurements.

Recrystallised samples of cerous nitrate and potassium salicylate were used and the solutions were prepared in conductivity water. Monovariation method was used to detect the formation of the complex. M/25 solutions of both, cerous nitrate and potassium salicylate, were employed, keeping the volume of cerous nitrate constant. The plot of conductance and the volume (in ml.) of potassium salicylate showed a break indicating the formation of a 1 : 3 complex between cerous nitrate and potassium salicylate. The results of the pH measurements were in accord with the above.

The composition of the complex was further confirmed by applying the Job's continuous variation method.[3] Three sets of equimolar solutions of cerous nitrate and potassium salicylate were employed. In the first set the strength of the two solutions was M/20, whereas in the second and third sets the strengths were M/30 and M/40, respectively. In all the three cases the plots between difference in conductance and percentage of potassium salicylate exhibited the maxima at 75% of potassium salicylate. This confirmed the formation of 1 : 3 complex between cerous and salicylate ions. Since the cerous salicylate complex precipitates out after some time, only dilute solutions should be employed. The complex formation may be represented by the following equation :

$$Ce(NO_3)_3 + 3C_7H_5O_3K \rightarrow Ce(C_7H_5O_3)_3 + 3KNO_3$$

The instability constant of the cerous salicylate complex was also determined by Job's continuous variation method using three sets of non-equimolar solutions of cerous nitrate and potassium salicylate, *viz.*, M/20 solution of potassium salicylate with M/30, M/40 and M/60 solutions of cerous nitrate. The average value of the instability constant of cerous salicylate was found to be $2{\cdot}468 \times 10^{-8}$ at 29° C.

Detailed results of the work will be published later.

Dept. of Chemistry, A. K. BHATTACHARYA.
University of Saugar, M. C. SAXENA.
Saugar (M.P.), *January* 5, 1960.

1. Varma and Mehrotra, *J. Ind. Chem. Soc.*, 1958, **35**, 381.
2. Hans Potratz, *Ger.*, Sept. 28, 1953, **398**, 846 (Cl. 120, 127).
3. Job, P., *Ann. Chem.*, 1928, **9**, 113.

## SPECTROPHOTOMETRIC INVESTIGATION ON COPPER MUREXIDE COMPLEX

MUREXIDE or ammonium purpurate is employed extensively as the metal ion indicator in Swarzenbach titrations of $Ca^{2+}$ using ethylenediamine tetra-acetic acid (EDTA). During the course of development of a method for estimation of $Cu^{2+}$ using EDTA, it appeared necessary to examine the nature of the copper-murexide complex ($Cu_y$–$Mu_x$) and the corresponding stability constant ($k$) on which no data exist in the literature.

Murexide of B.D.H. quality was purified by Davidson's method[5] and was found to be 99·9% pure.[6] Copper sulphate was a Merck sample and was recrystallised in double distilled water. The solutions of these substances were prepared by weighment. Absorption measurements were made on Beckman DU Spectrophotometer using 1 cm. corex and silica cells and dual thermospacer set no. 2180 for maintaining the temperature ; in the experiments reported herein the temperature was 25 ± 0·2° C.

In accord with the data of Swarzenbach and Gysling,[7] murexide gave characteristic absorbance maxima at $\lambda = 245$, 325 and 520 mμ. Addition of $Cu^{2+}$ to murexide solution caused a shift of the maxima at $\lambda = 245$ and 520 mμ while the maximum at $\lambda = 320$ was not affected. The shift was, however, marked at $\lambda = 520$. The complex exhibited maxima at $\lambda = 230$ and 480 mμ. All absorption measurements characteristic of the complex were made at $\lambda = 480$.

Studies on Job's method of continuous variation[8] for investigation of the composition of the complex showed that this last was un-unimolecular type (Cu-Mu). The following equation for the value of K can be deduced.

$$K = \frac{(D - C^{\circ}_{X}\epsilon_{X})\ (\epsilon_{MX} - \epsilon_{X})}{(C^{\circ}_{X}\epsilon_{MX} - D)\ \{\epsilon_{X}\ (C^{\circ}_{X} - C^{\circ}_{M}) + C^{\circ}_{M}\epsilon_{MX} - D\}}$$

where D is the observed optical density, $\epsilon$ and $C^{\circ}$ refer to the molar extinction coefficients and initial concentrations respectively, of different species denoted by subscripts. The data in Table I, columns 4 and 7 refer to the classical dissociation constant of the complex ; while the thermodynamic values calculated from modified Debye-Huckel equation[9] are returned in columns 5 and 8. It is of interest to note that pK was p*H*-dependent, which follows from the

TABLE I

| Conc. of $Cu^{++} \times 10^{5}$ M | Conc. of murexide $\times 10^{5}$ M | pH 5 Optical density at $\lambda = 480$ m$\mu$ | p$\epsilon$ | p$K$ | pH 6 optical density at $\lambda = 480$ m$\mu$ | p$\epsilon$ | p$K$ |
|---|---|---|---|---|---|---|---|
| 0·8 | 7·2 | 0·078 | 3·31 | 3·32 | 0·085 | 3·59 | 3·60 |
| 1·6 | 6·4 | 0·157 | 3·42 | 3·43 | 0·162 | 3·53 | 3·54 |
| 2·4 | 5·6 | 0·233 | 3·34 | 3·36 | 0·236 | 3·21 | 3·53 |
| 3·2 | 4·8 | 0·298 | 3·38 | 3·40 | 0·306 | 3·57 | 3·59 |
| 4·0 | 4·0 | 0·366 | 3·40 | 3·43 | 0·370 | 3·48 | 3·50 |
| 4·8 | 3·2 | 0·426 | 3·38 | 3·40 | 0·434 | 3·55 | 3·57 |
| 5·6 | 2·4 | 0·480 | 3·39 | 3·42 | 0·488 | 3·61 | 3·64 |
| 6·4 | 1·6 | 0·535 | 3·35 | 3·38 | 0·545 | 3·53 | 3·56 |
| 7·2 | 0·8 | 0·587 | 3·47 | 3·50 | 0·590 | 3·57 | 3·60 |

mechanism of the metal-murexide complex formation.

The details will appear elsewhere.

Thanks are due to Prof. S. N. Gundu Rao, Director, for his kind interest in the work ; to Dr. N. A. Ramaiah, Head of the Department, for continued guidance and helpful discussions ; and to the Ministry of Scientific Research and Cultural Affairs, Government of India, for a maintenance grant.

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## THE NEAR ULTRAVIOLET ABSORPTION SPECTRA OF FLUOROXYLENES

THE near ultraviolet absorption spectra of five out of six possible fluoroxylenes [1-fluoro 2, 3 dimethyl (I), 1-fluoro 2, 6 dimethyl (II), 1-fluoro 2, 4 dimethyl (III), 1-fluoro 2, 5 dimethyl (IV), 1-fluoro 3, 4 dimethyl (V) benzenes] have been studied in the vapour phase. The longest wavelength band system corresponding to $A_{1g}$–$B_{2u}$ transition of benzene is recorded and the vibrational analysis proposed. All the compounds belong to $C_s$ symmetry, excepting II which corresponds to the approximate symmetry $C_{2v}$. The corresponding transition in all the compounds is hence allowed.

The 0-0 bands in these spectra are fixed at 37397 (I), 37358 (II), 36610 (III), 36919 (IV) and 36892 (V) cm.$^{-1}$ respectively for compounds I to V. The position of the 0-0 band appears to depend on the type of substitution namely, 1, 2, 3-type or 1, 2, 4-type into which all the compounds fall. The shifts of the 0-0 bands from the corresponding ones in benzene have been explained on the basis of the theory by Forster,[1] or Goodman and Shull[2] for the substitution effect in disubstituted benzenes.

The prominent progression forming excited state frequency in these compounds I to V is found to be 636, 632, 694, 691 and 691 cm.$^{-1}$ respectively. In addition to this, three other frequencies could be definitely identified and assigned to the modes of vibration in all the cases. Certain generalisations as regards the relative excitation of the two benzene skeletal vibrations corresponding to 992 $a_{1g}$ and 1010 $b_{1u}$ of benzene with respect to the type of substitution in trisubstituted benzenes are drawn. It is also observed that substituent frequencies are intimately related with the type of substitution.

The detailed paper is proposed to be published elsewhere.

Dept. of Chem. Tech., Bombay-19, *January* 19, 1960.
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T. S. VARADARAJAN.

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## SULPHUR DIOXIDE AND PIPERIDINE COMPLEXES

SULPHUR dioxide is known to combine with numerous aliphatic,[1-3] aromatic[4-7] and heterocyclic[8] amines (primary, secondary or tertiary) to form yellow addition products. These complexes were found to contain sulphur dioxide and amine in the molar ratio of 1 : 1. The complexes would easily dissociate. Addition compounds other than 1 : 1 were claimed to exist only in the presence of water and correspond to normal and acid sulphites[5] which would normally be colourless. During the course of our investigation on the chemical behaviour of sulphur compounds, we found that in addition to the 1 : 1 compound reported in literature, piperidine and sulphur dioxide would form a 2 : 1 complex which was snow-white in colour. The details of preparation and analysis of these two complexes are described in this communication.

The products of reaction between piperidine and sulphur dioxide were found to be extremely hygroscopic and it became essential to carry out all the operations under extremely dry conditions, preferably in a dry box.

### PREPARATION OF 1 : 1 COMPOUND ($C_5H_{10}NH.SO_2$)

8·5 g. (0·1 mole) of piperidine was dissolved in about 100 ml. of petroleum ether and dry sulphur dioxide was passed till the solution showed a strong smell of sulphur dioxide.[9] The reaction mixture was cooled in ice during the passage of sulphur dioxide. The yellow solid that separated out was filtered quickly, washed with more petroleum ether and dried over phosphorus pentoxide in a vacuum desiccator. The total sulphur content, as determined by the Carius method was found to be 21·16%, the theoretical value is 21·47%.

### PREPARATION OF THE 2 : 1 COMPLEX ($(C_5H_{10}NH)_2SO_2$)

About 10 g. (0·12 mole) of piperidine was dissolved in 100 ml. of petroleum ether. The solution was cooled in ice and nearly 1 litre (·045 mole) of dry sulphur dioxide was slowly absorbed in it. The snow-white solid that separated out was filtered quickly, washed with petroleum ether and preserved over phosphorus pentoxide in a vacuum desiccator. The total sulphur content of the complex as determined by Carius method gave a value of 14·30% as against the theoretical value of 13·66%.

It has to be pointed out that it is extremely difficult to avoid the contamination of this complex with the 1 : 1 yellow compound. When sulphur dioxide was bubbled through the petroleum ether solution of piperidine, the point at which the gas came in contact with the liquid was rich in sulphur dioxide and gave a small amount of a yellow deposit. This is perhaps the reason for a slightly higher content of sulphur in the compound.

The composition of the two addition compounds was also established by oxidation reactions using standard iodine and chloramine-T solutions.

A weighed amount of the compound was dissolved in water and made up to a known volume. Aliquots of this solution were run into a known excess of either iodine or acidified chloramine-T solution. Excess of oxidants were determined by titrating with standard thiosulphate solution. Taking the molecular weights of $(C_5H_{10}NH)_2SO_2$ and $C_5H_{10}NH.SO_2$ to be 234 and 149 respectively, the number of equivalents of the oxidants reacting with 1 mole of the compound was calculated. The results of the oxidation reactions are given in Table I.

It can be made out from Table I that two equivalents of the oxidant, either iodine or

TABLE I

*Oxidation of* 1 : 1 *and* 2 : 1 *complexes of piperidine-sulphur dioxide with iodine and chloramine-T*

| Compound | Oxidation with iodine | | | Oxidation with chloramine-T | | |
|---|---|---|---|---|---|---|
| | Moles of compound taken × $10^4$ | Eq. of iodine consumed × $10^4$ | Eq. of iodine reacting with 1 mole of compound | Moles of compound taken × $10^4$ | Eq. of oxidant consumed | Eq. of oxidant reacting with 1 mole of compound |
| $C_5H_{10}NH.SO_2$ .. | 10·50 | 19·80 | 1·89 | 10·50 | 19·90 | 1·90 |
| | 10·50 | 19·70 | 1·88 | 5·20 | 10·00 | 1·92 |
| $(C_5H_{10}NH)_2SO_2$ .. | 4·75 | 9·43 | 1·99 | 4·75 | 10·15 | 2·14 |
| | 3·60 | 7·63 | 2·12 | 3·60 | 7·52 | 2·09 |

chloramine-T are necessary for the oxidation of 1 mole of each of the addition compounds. The reactions may be represented in the following way.

(*a*) 1. $C_5H_{10}NH.SO_2 + I_2 + 2H_2O \rightarrow C_5H_{10}NH + H_2SO_4 + 2HI$

2. $(C_5H_{10}NH)_2SO_2 + I_2 + 2H_2O \rightarrow 2C_5H_{10}NH + H_2SO_4 + 2HI$

(*b*) 1. $C_5H_{10}NH.SO_2 + O + H_2O \rightarrow C_5H_{10}NH + H_2SO_4$

2. $(C_5H_{10}NH)_2SO_2 + O + H_2O \rightarrow 2C_5H_{10}NH + H_2SO_4$

Sulphur dioxide complexes with the secondary and tertiary amines are more stable than those with primary amines.[1,4,5] The dissociation is less in the former case than in the latter. Therefore no vapour pressure measurements could be made with the compounds prepared from sulphur dioxide and piperidine. They did not record any perceptible vapour pressure at room temperature (25°) but began to decompose at elevated temperatures.

SUMMARY

1 : 1 and 2 : 1 addition compounds of piperidine and sulphur dioxide were isolated and characterised by their oxidation with iodine and chloramine-T.

Our thanks are due to Prof. M. R. A. Rao for his keen interest in the work.

Dept. of Inorganic and Physical Chem., Indian Institute of Science, Bangalore-12, *February* 1, 1960.

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## CHEMICAL INVESTIGATION OF 'OOS' NATURAL DEPOSITS NEAR KAPADVANJ

WITHIN a radius of 10 miles of Kapadvanj, the taluk a headquarter of the Kaira District of Bombay State, situated on 23° 1' 30" N. latitude and 73·4° E. longitude at a distance of about 32 miles from Ahmedabad, white crystalline patches of deposits known as 'OOS' are found at several places. The 'OOS' is collected by the local population and used as a cleansing agent for domestic purposes. It is also used industrially for soap manufacture.

After the monsoon is over, the 'OOS' begins to appear on the surface of the soil as a white light crystalline powder. As the temperature in winter drops lower and lower, the 'OOS' formation increases significantly. With the onset of summer, it practically ceases.

We recently (6th February 1960) collected several samples from different places within a radius of nearly three miles of Kapadvanj, in the vicinity of Somnath village. They have been analysed and the results of the analysis are given below :

| | |
|---|---|
| Silica (sand) 50%. | Calcium 0·1-0·2%. |
| Total Carbonate 30-35%. | Aluminium traces only. |
| Bicarbonate 14-15%. | Magnesium and Iron absent. |
| Chloride 0·7-0·8%. | Sulphate absent. |

The above constituents are in the form of their sodium salts. The samples are completely soluble in water, the silica settling at the bottom.

The soil is sandy and loose with plenty of moisture. No crops are raised in this area ; only grass grows round about. Similar deposits are also found in other adjoining areas. It is worth mentioning that the famous Lasundra hot springs are situated within a distance of nearly eight miles. However, it is interesting to note that no sulphate or free sulphur has been found in the 'OOS' deposits.

Further work is in progress.

Dept. of Chemistry, St. Xavier's College, Ahmedabad-9, *February* 22, 1960.

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## CONSTITUTION OF MANGIFERIN

THE crystalline compound, mangiferin, was originally isolated from the leaf and bark of the mango tree.[1] More recently, it has been obtained from the unripe fruit by S. Iseda[2] and from the heartwood by us. The yields from the bark are the highest (about 2·5%). The same crystalline principle is considered to be present in the roots of *Salacia prinoides* Linn.[3]

Just as our work on the constitution of mangiferin was in progress, Iseda published his finding that the compound is a xanthone derivative. Our results agree with his in this respect. He considers that it is the glucoside of 1 : 3 : 6 : 7-tetrahydroxy xanthone with the sugar group linked in the 7-position ; the evidence was based on analytical values, infra-red spectra and

colour reactions, and no rigorous proof was given for the presence of glucose unit and its linking.

The results of our experiments are as follows:

1. The derivatives of mangiferin are difficult to obtain in the crystalline condition. But by using special methods, it has been possible to prepare a crystalline methyl ether.

2. Two methyl ethers can be obtained:— (i) The first was formed by the action of diazomethane and could be obtained crystalline. It contained about three methoxyl groups and had a resistant phenolic hydroxyl free. (ii) By prolonged boiling with methyl sulphate and potassium carbonate in acetone as the medium, a syrupy methyl ether was obtained which did not show appreciable hydroxyl absorption in the infra-red spectrum. It would appear that the alcoholic hydroxyls were also methylated.

3. Hydrolysis of the glucoside does not take place by the use of (i) dilute mineral acids and (ii) enzymes. It requires boiling with hydriodic acid in the presence of phenol for 6 to 7 hours. The tetrahydroxy xanthone could be obtained crystalline, after purification through acetylation.

4. The difficulty of hydrolysis of mangiferin and the fact that the sugar could not be isolated showed that it is not linked to oxygen.

5. The methyl ether (i) was subjected to periodic acid oxidation. It consumed about 2·3 moles of the acid and gave formic acid,[4] as one of the products. The dialdehyde obtained *in situ* was reduced with sodium borohydride; the product so obtained on treatment with concentrated hydrochloric acid gave glycerol, identified by paper chromatography.[5-7] Mangiferin itself gave varying results with periodic acid oxidation, due to the interference of the phenolic groups.

6. All these findings lead to the conclusion that the sugar is probably glucose and it is directly linked to a nuclear carbon atom. It is suggested that the concerned carbon atom is most likely to be in the 2-position of the xanthone nucleus.

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## PAPER CHROMATOGRAPHY OF ANTIOXIDANTS: A SIMPLE METHOD OF IDENTIFICATION AND SEPARATION

FOUR common antioxidants, *e.g.*, BHA (Butylated hydroxy anisole), NDGA (Nordihydroguaiaretic acid), BHT (Butylated hydroxy toluene) and PG (Propyl gallate) were investigated for their identification and separation. The question of separation is also important inasmuch as antioxidants are sometimes used in combination for synergistic action. Mitchell[1] worked with the same antioxidants but with a different chromatogram and different solvents. The method advocated in this communication is rapid and simple.

Liquid paraffin was used as the stationary phase. Whatman No. I filter-paper was impregnated with a 7% solution of liquid paraffin B.P. in petroleum ether, 60-80. The details of operation for preparing the chromatogram are given in a previous publication.[2]

Two kinds of mobile phase were tried for running the chromatogram, *viz.*, (*a*) 20% methanol (20 vol. methanol + 80 vol. water) and (*b*) 5% ethyl acetate prepared by diluting 5 vol. of the reagent to 100 vol. with water; this latter solvent was previously used by Yasuhara and Masuyama.[3]

Ammoniacal silver nitrate was used as the developer: to a 10% aqueous solution of $AgNO_3$, ammonia (0·88 sp. gr.) was added dropwise until the precipitate first formed dissolved, and then a slight excess of ammonia was kept.

A 1% solution of four antioxidants in alcohol was used for spotting the chromatogram. After 4 hours' descending run the chromatogram was taken out and immediately sprayed with the developer. Within about 10 min. black spots appeared. Table I gives the $R_f$ values of the antioxidants spotted individually.

TABLE I

| | Antioxidants | $R_f$ values | |
|---|---|---|---|
| | | 20% Methanol | 5% Ethyl acetate |
| 1 | BHT | 0·0 | 0·0 |
| 2 | BHA | 0·3 | 0·1 |
| 3 | NDGA | 0·4 | 0·2 |
| 4 | PG | 0·6 | 0·4 |

From a mixture of all these four the individuals were separated on the chromatogram and found to have the same $R_f$ values as in Table I.

As noted previously,[2] it was found in general that, (i) the larger the concentration of the stationary phase the smaller were the $R_f$ values of the antioxidants with any one mobile phase, and (ii) the larger the percentage of methanol in the mobile phase the greater were the $R_f$ values with any one stationary phase.

The 20% solution of methanol as used here has been found to be convenient in that it gives a good resolution of the mixture and runs fairly well, *ca.* 32 cm. in 4 hours. The greater the percentage of methanol in the solution the less is the length of the run.

Formation of spots, however, appeared to be slightly better with ethyl acetate.

PG and NDGA assumed black colour with the developer instantaneously. BHA and BHT took some time, about 10 min. Spot of BHA was not well formed; it was rather diffused.

During the preparation of the stationary phase, the concentration of liquid paraffin solution is apt to change because of the volatility of the solvent. This should be remembered to obviate unnecessary variations in R value. In all cases comparison with known antioxidants side by side will be a good check.

Central Food Lab., B. R. Roy.
Calcutta-16, S. N. Mitra.
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## OXALATE CONTENTS OF LEAFY VEGETABLES

Green leafy vegetables, which are rich in vitamins and minerals, are usually recommended to overcome the deficiency of calcium in the common Indian diet.[1,2] It has, however, been reported that plant tissues contain considerable amounts of soluble oxalates,[3–5] which render the calcium unavailable in the diet, by forming insoluble calcium oxalate. In view of the significance of the presence of oxalates in relation to the availability of calcium, the common leafy vegetables were analysed for these constituents and the results are reported here.

Calcium was determined by the Volumetric calcium oxalate-permanganate titration method from an aliquot of the HCl extract of the plant samples, while soluble and total oxalates were determined by the method of Baker[6] after extracting the samples with water and dilute hydrochloric acid respectively. The results given in Table I, represent the percentage on fresh edible portion of the leafy vegetables.

Table I

| Sl. No. | Vegetable | Soluble oxalates % | Total oxalates % | Calcium % |
|---|---|---|---|---|
| 1 | Radish (*Raphanus sativus*) | 0·395 | 0·676 | 0·246 |
| 2 | Spinach (*Spinacia oleracia*) | 0·958 | 1·014 | 0·098 |
| 3 | Fenugreek (*Trigonella fœnum græcum*) | 0·479 | 0·544 | 0·137 |
| 4 | Lettuce (*Letuca sativa*) .. | 0·197 | 0·366 | 0·054 |
| 5 | "Ambadi" (*Hibiscus sabdoriffa*) | 1·098 | 1·916 | 0·178 |
| 6 | "Chakwat" (*Chenopodium album*) | 0·873 | 1·423 | 0·268 |
| 7 | Amaranth (*Amaranthus gangeticus*) | 0·732 | 1·944 | 0·340 |
| 8 | "Shepu" (*Peucedanum graveloleus*) | 0·423 | 0·620 | 0·131 |
| 9 | Safflower (*Carthamus tinctorus*) | 0·338 | 0·479 | 0·193 |
| 10 | Coriander (*Coriandrum sativum*) | 0·845 | 1·268 | 0·161 |
| 11 | Curry leaves (*Murraya kænigii*) | 1·155 | 1·352 | 0·634 |
| 12 | Betel leaves (*Piper betel*) .. | 1·239 | 1·350 | 0·233 |

The data show that soluble oxalates form more than half of the total oxalate content of the leafy vegetables except Amaranth. Similarly, the total oxalate contents are 2 to 8 times the amount of calcium in all the vegetables. This shows that practically all the calcium from these leafy vegetables is unavailable. Consumption of such oxalate rich foods would, therefore, further aggravate the existing deficiency of calcium. Cheap leafy vegetables are indispensable in the poor Indian diet. It would, therefore, be advisable to take suitable measures to neutralise the effect of oxalates. One such method, largely followed in India, is the application of slaked lime to "pan" (betel leaf) before consumption.

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*January* 9, 1960.

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## POSSIBILITY OF ECONOMISING IRRIGATION WATER BY USING BIOLOGICAL INDICATORS

SCHEDULING timely irrigations and thereby economising on irrigation water has been one of the major problems in irrigated agriculture. Recently various devices such as tensiometers, irrometers and resistance units have been developed and used in technologically more advanced countries to assess the soil moisture status in the cropped areas. These devices, no doubt, are quite precise and of proven worth but they have not been widely adopted by farmers because of their cost and of the technical knowledge required in their use. Farmers in this country would be benefited if a device suited to their conditions is developed. Use of biological indicators shows great promise in this field.

Sunflower is one such indicator plant as it is very sensitive to changes in soil moisture. As the soil moisture stress increases beyond a certain limit, the young leaves of the plant lose turgor and droop. They do not recover unless water deficit is made good. If wilting persists during the early morning hours it indicates a real moisture deficit in the soil. On account of its capacity to exhibit clearly the symptoms of moisture stress, sunflower has been employed in laboratory tests to determine the wilting point of soils. This use of sunflower can be extended to assess the soil moisture, particularly in field crops which have identical root zones.

An experiment was conducted at the I.A.R.I. farm to examine the utility of sunflower plant as an irrigation indicator in the crop of onion for bulbs. The choice fell on onions particularly for three reasons, (i) its shallow root system; (ii) the sunflower plants would not be shaded by the onion growth. The sunflower plants also do not shade onions as they are just solitary plants at only 2-3 places at random in about 1,000 sq. ft. area and grow only to a height of about 18-24"; (iii) onions need frequent irrigation and hence there is scope for economising irrigation water.

The experiment involved two treatments only —(*a*) irrigation at an interval of 10-12 days which is normally the practice followed by the cultivators, and (*b*) irrigation according to the symptoms of wilting sunflower. Irrigation was applied, when the topmost well-developed leaves showed loss of turgor. Symptoms were observed at 10 a.m. in the morning when there was no dew on the leaves. Onion is a shallow-rooted crop and hence only young sunflower plants 6-10 weeks old were used for examination of symptoms. Sunflower seeds were sown at fortnightly intervals in treatment B to obtain young seedlings at regular intervals. Onion and young sunflower plants have almost identical root zones during initial stages of growth. Later on as the sunflower plants developed deeper root system, they had to be rejected and other younger plants were selected for observations of moisture symptoms.

Onion seedlings were transplanted on 12th January 1959, at a distance of 8" × 3". The plot size was 40' × 20'. Each time a light irrigation was given till the water spread uniformly all over the plot. It was observed that irrigation water never percolated beyond a depth of 12" in the soil. Moisture studies were, therefore, confined only to the upper 12" of the soil layer. Although the water applied was not measured at the time of application, the quantity of moisture retained in the 12" zone was calculated according to the formula:

$$D = \frac{Ma - Mb}{100} \times Bd \times d.$$

Where D = Depth of water applied in inches at a particular irrigation.

$Ma$ = Moisture % in soil two days after the irrigation.

$Mb$ = Moisture % in soil just before irrigation.

$Bd$ = Bulk density of soil.

$d$ = Depth of the soil in inches (12").

Fresh weight of 20 bulbs at random was taken twice during the growth and finally the yield of bulbs from the whole plot was recorded. The crop was harvested on 3rd June, 1959. Data are presented in Table I.

TABLE I

| | Item | Treatment A | Treatment B |
|---|---|---|---|
| 1 | No. of irrigations received during the growth period | 9 | 6 |
| 2 | Total quantity of water received through irrigation | 16·54" | 13·30" |
| 3 | Water saved | .. | 3·24" |
| 4 | % of water saved | .. | 24·4% |
| 5 | Fresh wt. of 20 bulbs at 90 days in gm.<br>at 108 days in gm. | 403·6 ± 8·1*<br>1191·10 ± 58·7 | 425·0 ± 5·7*<br>1165 ± 41·5 |
| 6 | Final yield of onion bulbs in mds. per acre | 242·10 ± 13·90 | 211·36 ± 19·78 |
| 7 | Yield per acre inch of water applied | 14·6 mds. | 15·9 mds. |

* Initially three treatments were planned to be included in the experiment.

A = Irrigation according to cultivators' practice.
B = Irrigation according to sunflower symptoms.
C = Irrigation at 0·85 atm. moisture tension measured by a tensiometer. Treatment C could not be exercised during the season. These plots were, therefore, treated as those in treatment A. The S.E. worked out for treatment A above is, therefore, based on the pooled data for treatment A and C. Hence there are two S.E.s for treatments A and B as indicated in Table I.

Statistical analysis of the data showed that the differences in treatments are not significant at any of the three stages. The average yield of onions for every inch of water applied was more in treatment B than in the control A.

Preliminary results obtained show that economy of 24% can be exercised in the use of irrigation water to onion crop by using sunflower plant as an irrigation indicator.

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*November* 18, 1959.

## INTERACTION OF CHROMIC IONS WITH AMINO-ACIDS: SPECTROPHOTOMETRIC STUDIES OF CHROMIUM III COMPLEXES OF LYSINE, LEUCINE AND ASPARTIC ACID

CHROMIC ions do not readily undergo complex ion formation with amino-acids. The reaction is slow and the colour develops either on boiling or aging; the reaction is also reported to take place in alkaline medium. Most of the work done on such compounds is of analytical nature[1-3] and physical methods have rarely been employed. This communication deals with our spectrophotometric studies on the interaction of chromic chloride with lysine, leucine and aspartic acid.

Chromic-chloride A.R. (Green) was dissolved in doubly distilled water and the strength determined volumetrically.[4] Solutions of desired strength (0·04, 0·02, 0·0133) were prepared from the stock solution. Amino-acid solutions were prepared from E. Merck reagent grade samples. Job's method of continuous variation was employed for these studies. The mixtures were kept on a water-bath for about two hours (time of completion of reaction at 88° as observed from constant absorption value was found to be 52-60 minutes by separate experiments). Optical densities were measured using Beckman D.U. Spectrophotometer with the photomultiplier at sensitivity I, the source of light was a tungsten lamp. Cells used were Corex ones (1 cm.). For the selection of wavelength the solutions were mixed in the ratio 1 : 1, 1 : 2, 1 : 3, 1 : 4, 1 : 5 and 1 : 6. The maximum absorption took place between wavelengths 565 and 555 mμ for the ratios 1 : 2, 1 : 3, 1 : 4, 1 : 5 and 1 : 6 and at 580 mμ for the ratio 1 : 1 except in case of aspartic acid where maximum absorption for all ratios occurred between 555 and 565 mμ. Since the maximum absorption for the different ratios of amino-acids ranged between narrow limits Vosberg's method[5] could not be applied and a mean wavelength of 560 mμ was selected for carrying out the measurements. In all twenty-eight experiments were performed. Some of the curves (only for lysine) (vol. of $CrCl_3$ *vs.* difference of O.Ds. of the mixture and $CrCl_3$) are shown in Fig. 1. From the curves it was found that:

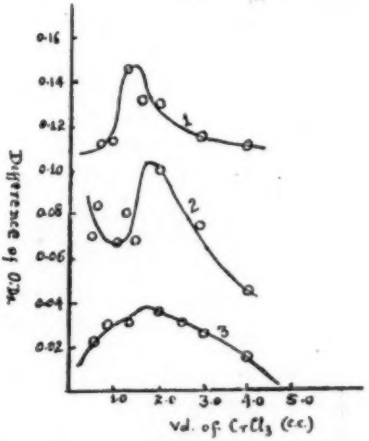


FIG. 1
CURVE 1. 0·04 $CrCl_3$ : 0·04 Lysine.
CURVE 2. 0·02 $CrCl_3$ : 0·02 Lysine.
CURVE 3. 0·0133 $CrCl_3$ : 0·0133 Lysine.

(i) For the concentration 0·04 M, leucine and lysine form complexes in the molar ratio ($CrCl_3$ : amino-acids) 1 : 3 while for the concentration 0·0133 M the ratio is 1 : 2 and for concentration 0·02 M the ratio for lysine (II) is 1 : 2 and that for leucine (I) is 1 : 3.

(ii) For concentrations 0·02 M and 0·0133 M aspartic acid forms complex (III) in the molar ratio 1 : 1.

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*December* 12, 1959.

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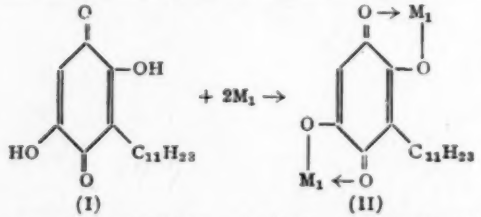
## METALLIC COMPLEXES OF EMBELIN

ALTHOUGH the isolation, constitution and synthesis of embelin[1] have been effected long time ago, its capacity to form metallic complexes has not been studied so far. Embelin (2 : 5-dihydroxy-3-undecyl-p-benzoquinone) was found to form complexes with nearly all metals under suitable pH conditions, water-insoluble compounds which are in most cases insoluble also in common organic solvents. The composition of these complexes could either be ascertained by direct weighing of the metallic complexes, followed by complete analysis for carbon, hydrogen and inorganic residue or conversion of the complexes to their metallic oxides. In all cases, simple combinations of metal ions with the hydroxyls of embelin have taken place giving rise to chelate structures (of type II), having a fairly fixed composition in a large number of cases. The complex with silver has two atoms of silver to one of embelin, those with copper, cadmium, barium, strontium, magnesium, nickel and zinc contain one atom of metal for one of embelin, while that of thorium is slightly of a variable composition.




(I) (II)

In the formation of these complexes of embelin with metal ions, precipitations have been carried out using excess of either of the reagents in molar proportions and the precipitation pH is adjusted using a Beckmann pH meter and in all cases, complexes of the same composition have been obtained. The colour of the complexes varied from pale green to deep violet. This study is further extended for estimation of metals using embelin as an analytical reagent.[2]

Table I gives a summary of the results obtained during this investigation using a number of metals.

TABLE I

| Embelate | Precipitation pH | Colour of the complex | Composition Metal : Reagent |
|---|---|---|---|
| Al (III) .. | 4·0–5·0 | Bluish violet | 2 : 3 |
| Ba (II) .. | 6·5–7·5 | Dirty green | 1 : 1 |
| Be (II) .. | 5·0–5·5 | Pale pink | 1 : 1 |
| Bi (III) .. | 3·0–4·0 | Dirty greenish black | 2 : 3 |
| Cd (II) .. | 6·0–7·0 | Greenish blue | 1 : 1 |
| Ca (II) .. | 6·0–7·0 | Dull violet | 1 : 1 |
| Ce (III) .. | 5·0–6·0 | Violet | Variable |
| Cu (II) .. | 6·0–6·5 | Brown violet | 1 : 1 |
| Co (II) .. | 6·0–7·0 | Violet black | 1 : 1 |
| Fe (III) .. | | Oxidises embelin in acid solutions | |
| Pb (II) .. | 6·0–6·5 | Deep dirty green | 1 : 1 |
| Li (I) .. | >7·0 | Violet | 2 : 1 |
| Mg (II) .. | 7·0–8·0 | Deep violet | 1 : 1 |
| Mn (II) .. | 7·0–7·5 | Greyish violet | 1 : 1 |
| Hg (II) .. | 2·0–3·0 | Orange yellow | .. |
| Ni (II) .. | 6·0–7·0 | Deep green | 1 : 1 |
| K (I) .. | >7·0 | Pale bluish pink | 2 : 1 |
| Rare earths | >6·0 | Violet | .. |
| Ag (I) .. | 7·0 | Violet black | 2 : 1 |
| Na (I) .. | >7·0 | Greyish purple | 2 : 1 |
| Sr (II) .. | 6·0–7·0 | Dull violet | 1 : 1 |
| Th (IV) .. | 0·4 N acid | Violet | Variable |
| Ti (IV) .. | Acid solutions | Dirty green | Variable |
| U (VI) .. | 6·0–6·5 | Dull violet | .. |
| Zr (IV) .. | Acid solutions | Dirty green | .. |
| Zn (II) .. | 6·5–7·5 | Pale bluish violet | 1 : 1 |

Further work would be published elsewhere.

Dept. of Chemistry, V. VENKATESWARLU.
Andhra University, CH. BHEEMASANKARA RAO.
Waltair, *January* 6, 1960.

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## ISOLATION OF HYPOGLYCEMIC PRINCIPLES IN THE ROOTS OF *CASEARIA ESCULENTA* ROXB.

THE roots of *Casearia esculenta* are used by the physicians practising in indigenous system of medicine as an antidiabetic agent.[1,2] Results of systematic chemical investigations recently carried out on the drug in our laboratories are reported here.

From the unsaponifiable fraction of the benzene extract, two sterols, m.p. 120–121° C. and

132°-133° C. respectively and one "Gutta" like substance m.p. 59-60° C. have been isolated.

From the alcoholic extract, two resin fractions, one of them water soluble but acid insoluble, and a crystalline water-soluble body "S", m.p. 132° C., containing C = 40·17% and H = 6·96% have been obtained. The resin fractions as well as the compound "S" are active hypoglycemic agents as tested on lowering of blood sugar levels of normal fasting (24 hrs.) albino rats. The following tables indicate the nature of the hypoglycemic effects. In each case three rats were used for the experiment and three for the control.

A reducing sugar is also present in the alcoholic extract of the drug which was identified as Arabinose by paper chromatography.

Department of Pharmaceutics, Banaras Hindu University, November 14, 1959.

N. K. Basu.
K. D. Choudhury.

TABLE I

*Concentration of blood sugar after a single oral dose of resins in mucilage of acacia*

Dose-2 gm./kg.

| Rat No. | Initial blood sugar (mg./100 ml.) | Blood sugar in mg./100 ml. after | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 hr. | 2 hrs. | 3 hrs. | 4 hrs. | 5 hrs. | 6 hrs. |
| Drug | | | | | | | |
| 1 | 113·40 | 79·46 | 84·70 | 87·10 | 89·10 | 92·20 | 94·07 |
| 2 | 116·10 | 84·70 | 92·19 | 94·77 | 90·10 | 94·30 | 100·26 |
| 3 | 110·70 | 76·96 | 82·04 | 92·19 | 87·60 | 91·50 | 96·31 |
| Mean variation | | −23·03 | −27·09 | −25·39 | −24·46 | −20·73 | −16·28 |
| Control | | | | | | | |
| 1 | 99·90 | 97·20 | 97·00 | 96·50 | 96·20 | 95·30 | 95·10 |
| 2 | 103·40 | 102·10 | 99·90 | 99·80 | 99·00 | 98·20 | 97·90 |
| 3 | 102·70 | 100·90 | 100·30 | 99·70 | 99·10 | 98·90 | 98·30 |
| Mean variation | | − 1·93 | − 2·93 | − 3·33 | − 3·90 | − 4·53 | − 4·90 |

TABLE II

*Concentration of blood sugar after a single oral dose of acid-insoluble resins in mucilage of acacia*

Dose-2 gm./kg.

| Rat No. | Initial blood sugar (mg./100 ml.) | Blood sugar in mg./100 ml. after | | | | |
|---|---|---|---|---|---|---|
| | | 2 hrs. | 4 hrs. | 6 hrs. | 8 hrs. | 10 hrs. |
| Drug | | | | | | |
| 1 | 100·20 | 87·10 | 76·58 | 82·20 | 93·50 | 99·00 |
| 2 | 103·10 | 90·10 | 79·20 | 84·70 | 96·20 | 100·10 |
| 3 | 107·20 | 96·40 | 85·50 | 90·30 | 100·30 | 101·50 |
| Mean variation | | −12·30 | −23·93 | −17·76 | − 6·83 | − 3·30 |
| Control | | | | | | |
| 1 | 114·60 | 112·30 | 110·70 | 108·80 | 107·50 | 107·10 |
| 2 | 106·60 | 105·70 | 104·80 | 102·30 | 101·20 | 100·30 |
| 3 | 109·00 | 108·30 | 107·20 | 105·10 | 103·80 | 102·90 |
| Mean variation | | − 1·30 | − 2·10 | − 4·66 | − 5·90 | − 6·63 |

TABLE III

*Concentration of blood sugar after a single oral dose of "S"*

Dose-0·5 gm./kg.

| Rat No. | Initial blocd sugar mg./100 ml. | Blood sugar in mg /100 ml. after | | | | |
|---|---|---|---|---|---|---|
| | | 2 hrs. | 4 hrs. | 6 hrs. | 8 hrs. | 10 hrs. |
| Drug | | | | | | |
| 1 | 120·20 | 102·70 | 93·90 | 100·90 | 106·10 | 110·80 |
| 2 | 107·70 | 87·10 | 78·60 | 87·20 | 90·50 | 95·60 |
| 3 | 111·90 | 96·60 | 89·20 | 93·70 | 88·70 | 103·40 |
| Mean variation | | −17·66 | −25·10 | −19·20 | −14·70 | − 9·86 |
| Control | | | | | | |
| 1 | 105·70 | 104·80 | 103·90 | 102·80 | 102·60 | 100·20 |
| 2 | 114·50 | 113·20 | 112·20 | 110·70 | 109·80 | 107·70 |
| 3 | 118·30 | 116·90 | 115·60 | 114·80 | 113·20 | 112·00 |
| Mean variation | | − 1·20 | − 2·26 | − 3·40 | − 4·20 | − 6·20 |

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## A NEW TECHNIQUE FOR PRESERVING PRAWN LARVAE

WHILE working on the post-embryonic development of *Caridina weberi* var. *sumatrensis* (de Man), difficulty was experienced in adequately fixing larval stages in reagents such as Picro-formol, Formalin and Alcohol, commonly used for the purpose. Flexure of the abdomen and distortion of natural form which resulted by using these reagents, rendered the material unsuitable for study. This necessitated finding suitable killing and fixing reagents. After testing a number of reagents, satisfactory results were obtained by the following :—

| Killing (Solution A) | | Preserving (Solution B) | |
|---|---|---|---|
| Potassium hydroxide | 8·75 g. | Formalin | 5 c.c. |
| Glycerine | 25·5 c.c. | Glycerine | 5 c.c. |
| Distilled water | 1,000 c.c. | Distilled water | 90 c.c. |

To avoid flexure, live larvæ were taken in a small petri-dish with a little quantity of water. To this were added a few drops of solution A and the larvæ left undisturbed for about five minutes during which they died in a well extended condition. They were then preserved in solution B. To remove traces of potassium hydroxide, two or three changes of the solution B were found necessary.

Material intended for examination of isolated appendages should be kept in solution A for 24-48 hours and then dissected in 5% glycerine solution in water.

Taraporevala Marine Biological Research Station, Taraporevala Aquarium, Bombay 2, *November* 26, 1959. M. K. THAKUR.

## CYTOLOGY OF MALE STERILE *CROTALARIA STRIATA* D.C.

A MALE sterile *Crotalaria striata*, was isolated in 1956 in the Agricultural Research Station, Hebbal, and the same has been reported to be of cytoplasmic type.[1] Cytological studies of that plant revealed the regularity of meiotic stages except the I Anaphase. Invariably, almost all the I Anaphase cells had chromatin bridges, the number of such bridges varying from 1 to 4 in each cell. None of the bridges seemed to have an accompanying fragment. The subsequent stages were quite normal. But all the pollen grains were sterile. The plant was allowed to be open pollinated and the $F_1$ progeny from the seeds thus produced was raised. All of them again were male sterile. Cytological studies of about 15 to 20 $F_1$ plants disclosed the recurrence of I Anaphase bridges not accompanied by fragments. The other stages were regular.

The causes for the appearance of I Anaphase bridges are many, noted amongst which are inversions, delayed terminalisation of chiasmata, fusion of chromosomal ends, genetic factors, etc. The critical examination of I Anaphase stage provides sufficient evidence to prove that they are not inversion type. Regular terminalisation of chiasmata was obvious from the studies of diakinetic stages, hence, the bridges may not be due to that factor. The fact that the bridges appear in the progeny also disproves the cause of bridges due to fusion of chromosomal ends, as there is no likelihood of the fusion bridges being persistent in the progeny. Alternatively, the gene may be considered as having its influence in bringing about irregular anaphasic separation. In this case the gene can be assumed to have mutated to bring about irregular I Anaphase separation. When such a plant is crossed with a plant with normal I Anaphase, the progeny ought to have shown regular I Anaphase due to restoration of the dominant gene responsible for normal I Anaphase separation. In view of the contrary results obtained, this phenomenon may be explained on the basis of presence of male sterile gene. Though, a normal gene for I Anaphase segregation has been restored from the male parent in the open pollinated cross, it is incapable of exhibiting its influence in association with the cytoplasm in which it is present. Therefore, it is correct to conclude that the gene cytoplasm reaction is assumed to have been responsible for the persistence of I Anaphase bridges in the progeny too.

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Botany Division, Agricultural College, Hebbal, Bangalore-6, *October* 24, 1959. C. KEMPANNA.

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## TURBIDIMETRIC CHLORIDE DETERMINATION

In the course of a preliminary study to determine anion exchange capacity and exchangeable anions in four soils exchangeable anions were extracted using 0·118 N NaOH. It was found that chloride anion could not be determined as such in the presence of free alkali. Even on neutralizing the free alkali with dilute nitric acid (1 : 2), chloride ions could not be determined by the usual volumetric procedure using potassium chromate indicator as it did not indicate the end-point. On the analogy of turbidimetric sulphate determination,[1] it was decided to determine the chloride turbidimetrically. The following procedure was adopted :—

1. *Preparation of standard solutions.*—Solutions containing known quantities of chloride as p.p.m. were prepared in water and in NaOH acidified with $HNO_3$. (5 ml. of 5·28 N $HNO_3$ were added to 150 ml. of 0·118 N NaOH.)

2. *Determination of the optimum wavelength.*—The wavelength of maximum absorption was determined by using two standard solutions having 7·1 and 21·3 p.p.m. of chloride in water. 1 ml. of 0·5% $AgNO_3$ solution was added to 5 ml. of the solution. The contents were mixed with a rocking motion. A distilled water blank was treated in the same way. The data obtained are given in Table I. These data indicate that there is no particular wavelength, where there is maximum absorption. Therefore it was decided to use a wavelength of 475 mμ, which gives an intermediate reading according to Table I.

TABLE I

*Transmission of light readings with silver chloride suspension of different wavelengths* (L)

| Wavelength | Blank | % Transmission 7·1 p.p.m. chloride | 21·3 p.p.m. chloride |
|---|---|---|---|
| 350 | 70 | .. | .. |
| 375 | 100 | 50 | 16·5 |
| 400 | 100 | 53·5 | 20·0 |
| 425 | 100 | 56 | 22·5 |
| 450 | 100 | 59 | 25·5 |
| 475 | 100 | 62 | 27·5 |
| 500 | 100 | 64·8 | 30·0 |
| 525 | 100 | 67·0 | 32·5 |
| 550 | 100 | 69·0 | 34·7 |
| 575 | 100 | 69·5 | 36·5 |
| 600 | 100 | 68·5 | 38·0 |
| 625 | 60 | .. | .. |

3. *Drawing of standard curve.*—Standard curves were drawn by plotting on semi-log paper the transmission percentage against p.p.m. of chloride in water, and in sodium hydroxide solutions acidified with $HNO_3$, using the wavelength of 475 mμ. The curves obtained are shown in Fig. 1. The transmission in the NaOH

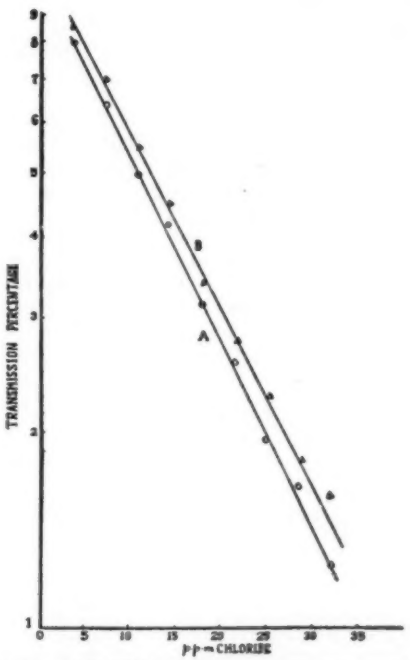


FIG. 1. Relationship between percentage transmission at 475 mμ and the chloride ion p.p.m. in suspension as colloidal AgCl.

A : Chloride in distilled water.

B : Chloride in NaOH acidified with $HNO_3$.

solution acidified with $HNO_3$ is throughout somewhat greater than that for the water solution. It may be that the $NaNO_3$ formed exerts some coagulating effect on the AgCl suspension.

Since a straight line is obtained by plotting percentage transmission against chloride ion concentration, the graph can be used for determining the chloride ion concentration in the unknown by simply measuring the percentage transmission using a photoelectric colorimeter.

Thus turbidimetric procedure gives a simple and quick method of determining chloride ions when present in small concentrations in acidified alkali extract or water extract.

I wish to thank Dr. C. F. Bentley, Professor of Soil Science and Dean of the Faculty of Agriculture, University of Alberta, Canada, for making useful suggestions during the course of this study.

Agri. Chem. Section, K. N. SYNGHAL.
Regional Research Centre,
Patiala, *November* 11, 1959.

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## CHROMOSOME NUMBER AND SEX MECHANISM IN SIXTEEN SPECIES OF INDIAN COLEOPTERA

A STUDY of sixteen species of beetles belonging to ten different families Hydrophilidæ, Coccinellidæ, Elateridæ, Curculionidæ, Meloidæ, Carbidae, Scarabæidæ, Tenebrionidæ, Cerambycidæ and Bruchidæ was undertaken to obtain more cytological information on Indian Coleoptera, which might add to our previous knowledge of nine Indian Species[1-3] worked out so far. The diploid chromosome number and the sex-determining mechanism of the species investigated (for the first time) are summarized in Table I.

The detailed study of the structure and behaviour of chromosomes will be published later. The work was carried out at the Department of Zoology, Allahabad University, Allahabad. The author is thankful to Prof. M. D. L. Srivastava for providing the necessary laboratory facilities and to Dr. A. P. Kapur, Zoological Survey of India, for the identification of the material.

Division of Microbiology, UMA AGARWAL.
Central Drug Research Institute,
Lucknow, *September* 22, 1959.

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TABLE I

| Species | Sex | Chromosome number ($2n$) | Sex mechanism | Chromosom formula |
|---|---|---|---|---|
| Family— HYDROPHILIDÆ : | | | | |
| 1 *Sternolophus rufipes* Fab. .. | ♂ | 18 | XX : Xy | 8AA+Xyp |
| | ♀ | 18 | | 8AA+XX |
| 2 *Berosus indicus* Mots. .. | ♂ | 18 | Xy | 8AA+Xyp |
| 3 *Hydrous indicus* Bedel .. | ♂ | 30 | Xy | 14AA+Xyp |
| Family— COCCINELLIDÆ : | | | | |
| 4 *Epilachna orientalis* Zimm. .. | ♂ | 18 | XX : XY | 8AA+XY |
| | ♀ | 18 | | 8AA+XX |
| 5 *Coccinella repanda* Thunbg. .. | ♂ | 20 | XX : Xy | 9AA+Xyp |
| | ♀ | 20 | | 9AA+XX |
| 6 *Coccinella septempunctata* Linn. .. | ♂ | 20 | Xy | 9AA+Xyp |
| 7 *Menochilus sexmaculata* Fabr. .. | ♂ | 20 | Xy | 9AA+Xyp |
| Family— ELATERIDÆ : | | | | |
| 8 *Heteroderus macroderus* Cand. .. | ♂ | 19 | XO | 9AA+X |
| Family— CIRCULIONIDÆ : | | | | |
| 9 *Astycus lateralis* Fabr. .. | ♂ | 22 | XX : Xy | 10AA+Xyp |
| | ♀ | 22 | | 10AA+XX |
| Family— MELOIDÆ : | | | | |
| 10 *Mylabris thunbergi* Pall. | ♂ | 22 | Xy | 10AA+Xyp |
| Family— CARABIDÆ : | | | | |
| 11 *Chlænius panagæoides* Chaud. .. | ♂ | 35 | XO | 17AA+X |
| Family— SCARABÆIDÆ : | | | | |
| 12 *Anomala dorsalis* Fab. .. | ♂ | 20 | Xy | 9AA+Xyp |
| Family— TENEBRIONIDÆ : | | | | |
| 13 *Gonocephalum elongatum* Fairm. .. | ♂ | 20 | Xy | 9AA+Xyr |
| Family— CERAMBYCIDÆ : | | | | |
| 14 *Batocera rubus* Linn. .. | ♂ | 20 | Xy | 9AA+Xyp |
| Family— BRUCHIDÆ : | | | | |
| 15 *Bruchus analis* Fabr. .. | ♂ | 20 | XX : Xy | 9AA+Xyp |
| | ♀ | 20 | | 9AA+XX |
| 16 *Pachymerus chinensis* L. .. | ♂ | 20 | Xy | 9AA+Xyp |

## RESPONSE TO PHOTOPERIODS OF *ORYZA* SPECIES

THE collection at the Central Rice Research Institute, Cuttack, of wild species of *Oryza*, were used for study of their flowering under different photoperiods. Most of the species could be maintained by vegetative propagation, their flowering at different seasons easily recorded and their photoperiod response compared with known genetic variability in the cultivated rice, *Oryza sativa*. In the cultivated varieties, flowering behaviour under different photoperiods, both natural and artificial, has been studied in detail by several workers and Ghose *et al.*,[2] have reviewed the results. Two main types of response are recognised in the *indica* group of rices, *viz.*, (a) short duration or period *fixed* rices which flower under all natural day-lengths in the tropics and (b) long duration or *season fixed* rices which require short days (long dark period) for flower initiation. Since the main rice season starts with the onset of monsoon in June or July, the long duration varieties automatically come under short day-lengths in October. Similarly when wild species are grown during the main rice season, it is seen that some species flower only after being subject to short day-lengths, while others flower even under long day-lengths. It is possible to classify the wild species as insensitive or sensitive to natural day-lengths, on the basis of their ability to flower in different seasons.

Ghose and Shastry[3] have confirmed the findings of previous workers that by subjecting long duration varieties to reduced day-lengths of eight hours daily, their flowering is hastened markedly. Shah[4] has shown that three of the four wild species of *Oryza* studied by him, were markedly sensitive to short day treatment, while the fourth was insensitive. The data from a parallel experiment with eleven species of *Oryza* are given in Table I. The plants were subjected to eight-hour day-length for 21 days, after the seedling stage growth of 35 days from germination.

The species in group A in Table I, can be termed sensitive and are comparable to long duration rice varieties, inasmuch as, flowering is hastened by short day treatment. The species in group B correspond to short or medium duration rice varieties. Even these show response to short day treatment though to a less extent; other experiments, however, have shown that they will flower even under long day lengths unlike species of group A. The material under group 'C', *viz.*, O. *perennis* var. *Barthii* may be considered an exceptional type needing further study, although commonly it is concidered as sensitive.

TABLE I

*Response of species of* Oryza *to short day (8 hr.) treatment (Date of sowing, 28th June 1955)*

| Group | Species | Date of flowering | | Days to flower (from germination) | | Hastening caused by treatment |
|---|---|---|---|---|---|---|
| | | Control | Treated | Control | Treated | |
| | | | | | | (days) |
| A | *O. glaberrima* var. *grandiglumis* | 14/10 | 20/9 | 108 | 84 | 24 |
| A | *O. perennis* var. *cubensis* | 23/10 | 2/10 | 117 | 96 | 21 |
| A | *O. latifolia* .. | 14/10 | 19/9 | 108 | 83 | 25 |
| A | *O. eichingeri* .. | 18/10 | 16/9 | 112 | 80 | 32 |
| A | *O. stapfii* .. | 29/10 | 28/9 | 123 | 92 | 31 |
| A | *O. ridleyii* .. (sown on 4-6-1955) | 1/11 | 16/9 | 150 | 114 | 46 |
| B | *O. australiensis* | 25/9 | 12/9 | 89 | 73 | 15 |
| B | *O. brachyantha* | 28/9 | 16/9 | 92 | 80 | 12 |
| B | *O. breviligulata* | 16/9 | 9/9 | 80 | 73 | 7 |
| B | *O. minuta* .. | 6/10 | 30/9 | 1000 | 94 | 6 |
| C | *O. perennis* var. *Barthii* | 26/10 | 24/10 | 120 | 118 | 2 |

Chandraratna[1] has shown that the range of photoperiods used should be stated when describing a variety of species as insensitive and that it is more accurate to describe it as low sensitive to given natural day-lengths rather than insensitive. Flowering in *O. australiensis* confirms this interpretation as it flowers in all seasons at Coimbatore, but at Cuttack with longer day-lengths, flowering is checked in July and August.

Parallel to variability in *O. sativa*, variation in photoperiod response has been found in wild species also and *O. officinalis* is a good example. The varieties of this species secured from Assam and Burma are short-day or sensitive types. A variety secured from Ceylon was completely insensitive and variety from Thailand was intermediate between these two types.

The species, *O. alta* grows and flowers best during long day-lengths and flowering appears to be inhibited by short day-lengths of October-November at Cuttack. No parallel instance is known amongst varieties of *O. sativa*. Similarly the wild rice *O. perennis* var. *Barthii* from

Africa, is not comparable to rice varieties of *O. sativa* in photoperiod response, as it flowers only during a particular season (October to December) and short-day treatment does not hasten its flowering. From observations of flowering in this type and in *O. coarctata* it is inferred that some other environmental factors or factor like humidity, has marked effect on flowering in some genotypes in the genus *Oryza*.

We are indebted to the Director, Central Rice Research Institute, for his encouragement and giving us facilities for completion of this study.

Central Rice Res. Inst., Cuttack-4, *February* 2, 1960.

W. T. Butany.
S. Sampath.

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## BEHAVIOUR OF THE BLACK BEAN APHIS IN SELECTING ITS HOST-PLANTS

Studies were carried out at this Institute with regard to the feeding preferences and the comparative fecundity of the laboratory-bred apteræ, adults and nymphs, of *Aphis fabæ* Scopoli on a number of its summer host-plants, *viz.*, *Vicia faba*, *Beta vulgaris*, *Urtica dioica*, *Capsella bursa-pastoris*, *Rheum rhubarbarum*, *Euphorbia cyparissias*, and *Philadelphus coronarius* L.

The data recorded showed that the aphids' readiness to stay and feed and their average reproduction rate varied between leaf and leaf not only of the same plant according to age differences, but also between leaves of one host plant and another. As a general rule, the aphis preferred the young leaves and reproduced better on them than on the mature ones, but they showed significantly less preference for *Capsella bursa-pastoris* and *Rheum rhubarbarum*, while they altogether failed to complete their development on *Euphorbia cyparissias*.

Chemical analysis of the cell sap, obtained directly from the stylet stumps of the aphid, left embedded in the plant tissue after the rest of the aphis was cut away, showed fairly great nutritional differences among the host-plants used in these studies. Thus, as Auclair and Maltais (1957) have already reported, the aphis rate of development and reproduction were found to be closely related to the amounts of sugars and amino-nitrogen present in the cell sap of the various host-plants. Thus when the percentage of amino-nitrogen was at a very low level, or in other words, when the absolute sugar contents were much higher than the absolute organic nitrogen contents in the cell sap, the aphis either increased the production of a late progeny or else turned brown and died away.

This *"Sugar-Nitrogen Ratio Index"* hypothesis is well supported by the studies carried out by Davidson (1925), Evans (1937), Kennedy (1958) and Maltais and Auclair (1957), who maintain that the departure of the aphid from a given host, which has lost vigour, could be due to the repellent action of the high concentrations of free sugars present in its cell sap. And since sugars are unnecessary or slightly utilised by the aphis, it must take in large quantities of plant sap in order to obtain the supply of nitrogenous food necessary for its normal development and reproduction and must void the excess moisture and carbohydrates. The presence of the high concentrations of sugars in the cell sap of a given host is, therefore, among one of the main factors which determine the suitability or unsuitability of that host for the use of the aphis.

A full account of this work will be published elsewhere.

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*January* 15, 1960.

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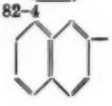
## CONDENSATION OF EPICHLOROHYDRIN WITH AROMATIC AMINES

In a projected synthesis of compounds of folic acid type, we investigated the reaction of epichlorohydrin with aromatic amines.

The condensation was usually carried out by mixing equimolecular quantities of the reactants in alcohol-medium in the presence of a drop or two of hydrochloric acid and keeping the reaction mixture for four days at room tem-

TABLE I

| $R\cdot NH\cdot CH_2\cdot CH(OH)\cdot CH_2Cl$ R = I, II, .... | | $R\cdot NH\cdot CH_2CH(OH)\cdot CH_2Cl$ picrate | | | $R\cdot NH\cdot CH_2CH\cdot CH_2$ (O) picrate | | | $R\cdot NH\cdot CH_2\cdot CH(OH)\cdot CH_2NH_2$ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | m.p. °C. | Analysis Calculated | Found | m.p. °C. | Analysis Calculated | Found | m.p. °C. | Analysis Calculated | Found |
| I | | 174 | C, 43·4; H, 3·6; N, 13·49; | 43·2 3·9 13·0 | 190–2 | C, 47·6 H, 3·7 N, 14·8 | 47·8 3·5 14·9 | .. | .. | .. |
| II Cl | | 134–5 | C, 40·09; H, 3·1; N, 12·4; | 40·5 3·0 12·6 | 181–2 | C. 43·6 H, 3·1 N, 13·5 Cl, 8·6 | 43·9 3·3 13·4 8·9 | 90 | C 53·7 H, 6·4 N, 13·9 | 53·9 6·3 13·9 |
| III $CH_3$ m.p. 82–4 | * | 145–6 | C, 44·8; H, 3·95; N, 13·68; | 44·7 3·8 13·9 | .. | .. | .. | | .. | .. |
| IV |  | .. | .. | .. | .. | .. | .. | 120° | C, 72·2 H, 7·4 N, 12·9 | 72·4 7·5 13·2 |

| $R\cdot NH\cdot CH_2\cdot CH(OH)CH_2Cl$ R = I, II, .... | | $R\cdot NH\cdot CH_2CH(OH)\cdot CH_2NH_2$ oxalate | | | $[R\cdot NH\cdot CH_2CH(OH)CH_2]_2NH$ | | |
|---|---|---|---|---|---|---|---|
| | | m.p. °C. | Analysis Calculated | Found | m p. °C. | Analysis Calculated | Found |
| I | | 159 | C, 56·87 H, 7·1 N, 13·2 | 56·8 7·4 13·5 | 136–7 | C, 68·5 H. 7·9 N, 13·3 | 68·7 7·9 13·2 |
| II Cl | | 214 | C, 48·87 H, 5·7 N, 11·45 Cl, 14·4 | 48·9 5·9 11·9 14·8 | 168–9 | C, 56·2 H, 6·0 N, 10·9 | 56·4 5·6 11·2 |
| III $CH_3$ m.p. 82–4° | * | 193 | C, 58·6 H, 7·5 N, 12·4 | 58·8 7·6 12·7 | 178–9 | C, 70·0 H, 8·4 N, 12·2 | 70·3 8·5 12·1 |
| IV | | 208–10 | C, 64·36 H, 6·5 N, 10·7 | 64·0 6·7 10·9 | 165 | C, 75·1 H, 7·0 N, 10·1 | 74·9 6·7 9·8 |

* Cohn and Friedlander (*Ber.*, **37**, 3034, 1904); Dains, Brewster, Clair and Thompson (*J. Am. Chem. Soc.* **44**, 2637, 1922).

perature. The resulting oily product was treated with a solution of picric acid in benzene, when crystalline picrates separated in most cases. The picrates on decomposition with lithium hydroxide yielded the free bases. The general structure assigned to the latter is,

$$R\cdot NH\cdot CH_2\cdot CH(OH)\cdot CH_2Cl \qquad (I)$$

where R is an aromatic nucleus.

By refluxing an ether solution of the bases over powdered potassium hydroxide, epoxy compounds of the type,

$$R\cdot NH\cdot CH_2\cdot CH\!-\!CH_2 \quad (O) \qquad (II)$$

resulted. In a few cases they were characterised by the preparation of picrates.

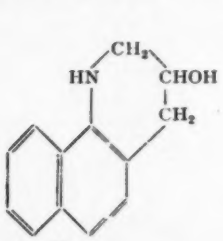
An interesting reaction was the action of ammonia, on the compounds with structures I and II, when primary and secondary bases, having the structures III and IV, were isolated, from both of them.

$$R\cdot NH\cdot CH_2\cdot CH(OH)\cdot CH_2\cdot NH_2 \qquad (III)$$

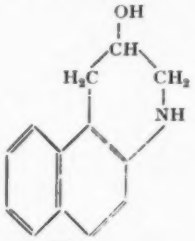
$$[R\cdot NH\cdot CH_2\cdot CH(OH)\cdot CH_2]_2NH \qquad (IV)$$

The reaction was usually carried out by keeping I or II with an alcoholic solution of ammonia for 48 hours. The oil left, after the removal of alcohol and ammonia, was generally found to be the secondary base which solidified

on keeping and was purified by crystallisation from alcohol. The supernatant aqueous layer on extraction with ether gave the primary base, generally isolated as oxalate. No tertiary base could be isolated from the reaction mixture. No pure prducts could be isolated from the condensation of p-anisidine with epichlorohydrin. The latter with α-naphthylamine at room temperature gave a mixture from which no pure substance could be isolated. However, at higher temperatures, 3-hydroxy-1, 2, 3, 4-tetrahydro-7, 8-benzoquinoline (V) was obtained.[1] Similarly, with β-naphthylamine, at higher temperatures 3-hydroxy-1, 2, 3, 4-tetrahydro-5, 6-benzoquinoline resulted. The crude reaction product from β-naphthylamine and epichlorohydrin (at room temperature), when treated with alcoholic ammonia, gave the compounds of the type III and IV.




V




VI

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Institute of Science, Bombay 1, *December* 1, 1959.

J. R. MERCHANT.
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## NOTE ON A NEW SPECIES OF *ARCHEGOSAURUS* FROM THE LOWER GONDWANAS OF RISIN SPUR (KASHMIR)

A NEW species of *Archegosaurus* (*Archegosaurus kashmiriensis* sp. nov.) has been discovered by the writer from the Lower Gondwana beds of Risin Spur (34°4′ N. 74°56′ E.) near Srinagar, Kashmir Valley, where he was engaged on field-work during 1958.

It may be recalled that earlier in 1902 Noetling discovered a portion of the left side of the skull of *Archegosaurus* from the same locality, which was described by Smith Woodward[1] as *Archegosaurus ornatus*. Since only a few Labyrinthodonts from the Lower Gondwana of Risin are known, this new find is of considerable importance. Moreover this specimen removes some of the doubts of Romer[2] about the correct generic position of *Archegosaurus ornatus* Woodward. The specimen is in a rock slab and is the impression of the dorsal surface of the skull.

FIG. 1. Photograph of the skull (external mould of *Archegosaurus kashmiriensis* sp. nov., from the Lower Gondwana bed of Risin (Kashmir). Note the triangular shape of the skull; Large, circular orbits; conspicious pineal foramen and lyra. Holotype; G.S.I. Type No. 17758.

*Diagnostic characters.*—Skull more or less triangular, longer than broad; snout elongated and narrow. *Pineal* foramen circular, conspicuous and is in the median suture between the Parietals. Orbits large, somewhat circular and lodged at the hinder region of the skull. Anterior nares are placed close to the border of the snout. Teeth conical, sharp and show the typical labyrinthodont structure. Entire surface of the skull is covered with scutes with minute pittings.

The new find has been referred to as *Archegosaurus, sensu lato*. The highly ornamented skull of Archegosaurus ornatus Woodward, with small and oval eyes, is easily distinguished from this species, which on the contrary possesses large, circular eyes and has a less conspicuous ornamentation. Moreover, in *A. ornatus* the otic notch is not deep and the slime canals are very well marked. The detailed description of the species is being published in the *Records of the Geological Survey of India*.

The writer is indebted to Dr. D. N. Wadia, F.R.S., for kindly reading the manuscript of the detailed paper and for his valuable suggestions.

Geological Survey of India, A. P. TEWARI.
Calcutta, *November* 16, 1959.

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## SOME NEW PLANT FOSSILS FROM UPPER GONDWANAS OF KRISHNA DIST., ANDHRA PRADESH

THE equivalent beds of the Rajmahals of the Upper Gondwanas of India are represented on the east coast near Atgarh (85° 41′ : 20° 31′), Gollapalli (80° 58′ : 16° 43′), and Budavada (80° 12′ : 15° 51′). Formations from the last two areas were described in detail by King[1] and those at Atgarh by Fox.[2] The fossil flora was studied by Fiestmantel[1,3] and includes species of Filicies, Cycadeaceæ and Coniferas.

The area to the north of Gollapalli included between 80° 51′ 30″ East Long. and 81° 0′ East Long., and 16° 45′ North Lat., and 17° 0′ North Lat., was mapped in detail by the author[4] and the continuity of the Gollapalli sandstone formation northwards was established. The fossil content was subjected to a careful study and brings to light two interesting features: the occurrence of equisetateous stem compressions in shaly

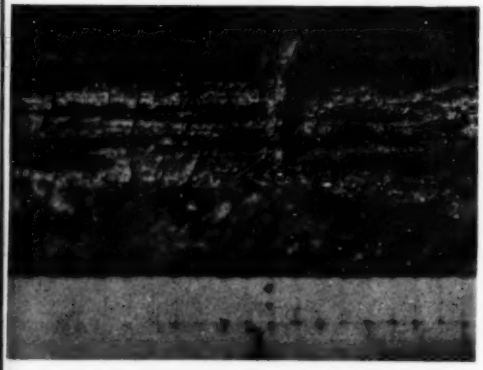

FIG. 1

sandstones in two localities, and a petrefaction of a gymnosperm wood by iron oxide.

The compressions are from near Buruvancha ((80° 50′ 30″ : 16° 52′) and Digavalli (80° 53′ : 16° 52′). One of them which is a part of a stem compression about 3″ in length is shown in Fig. 1. A single node and two incomplete internodes can be made out from the figure. The internodes are ribbed and traversed by regular, more or less parallel and closely spaced ridges and grooves. The ridges of the upper internode seem to be alternately placed to those of the lower ones. The grooves also have a similar disposition. Owing to the poor state of preservation, it has not been possible to compare the fossil with any known species described from India and to identify the species. The compression, however, can be referred to the form genus "Equisetites". It may be mentioned that, though Equisetites are known from Rajmahal area, this is the first report of their occurrence from the Upper Gondwanas of the South-eastern coast of India.

The petrified fossil wood is from Ramanakkapeta (16° 52′ 30″ : 80° 52′ 30″). It is brownish-yellow in colour, soft and porous and is attached to a fine-grained ferruginous conglomerate occurring in the bottom beds of the Gollapalli sandstone formation. The petrifying material is limonite, as revealed by standard tests.

Arnold[5] observed that about twenty mineral substances are known to cause petrefaction but those most frequently encountered are silica, calcium carbonate, magnesium carbonate, and iron sulphide (either pyrite or marcasite). Petrefaction by iron oxide is considered as a rarity.

With a view to ascertain the nature of the petrifying agent, chemical tests[6] were carried out and the following conclusions drawn. The negligible residue obtained by dissolving the fossil wood in hydrochloric acid shows that the true petrifying agent was not silica. It could not be a case of simple impregnation, for there was no charring or smoking when the substance was heated. Non-occurrence of pyrite in the associated rocks and the absence of odour or of any other evidence of evolution of hydrogen sulphide, precluded the possibility of an original petrefaction by pyrite followed by oxidation. Iron oxide is suggested to be the original petrefying agent.

The author is grateful to Prof. C. Mahadevan for guidance and criticism, and to Dr. C. G. K. Ramanujam for help.

Dept. of Geology, B. B. G. SARMA.
Andhra University,
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## PROTOPECTINASE ENZYME SECRETION BY *PENICILLIUM EXPANSUM* LINK IN THE INFECTED FRUITS

EARLIER investigations have shown that *Rhizopus stololifer* and *Penicillium expansum* are the causes of serious 'soft rot' diseases in many fruits of Naini Tal.[1,3] It has also been shown that *R. stolonifer* secretes active protopectinase enzyme while attacking various fruits.[4]

Different fruits were inoculated by *P. expansum* by the method mentioned by Bhargava and Gupta[1] and incubated in tin boxes at 25° C. for seven days. After the incubation period, the sap was extracted from the rotten tissues of the fruits, centrifuged and the clear liquid was tested for the activity of protopectinase enzyme by the method given by Brown.[2] The activity of the enzyme was noted as the time taken to macerate potato discs of standard size.[4]

It was observed that active protopectinase enzyme was extracellularly secreted by *P. expansum* in the fruits which were attacked by it. Apples and peaches were found to be more suitable for the enzyme secretion. The results are shown in the following table.

*Production of protopectinase enzyme in different fruits*

| Sl. No. | Fruits | Maceration time (minutes) |
|---|---|---|
| 1 | Apple *Var.* green sweet | 35- 40 |
| 2 | Apple *Var.* king tomkin | 60- 70 |
| 3 | Peach | 65- 75 |
| 4 | Plum | 100-110 |
| 5 | Pear | 140-150 |

The author is grateful to Shri D. K. Pandey for his help and to the Scientific Research Committee, U.P., for financial aid.

Botany Department, S. C. GUPTA.
Th.D.S.B. Government College,
Naini Tal, *September* 12, 1959.

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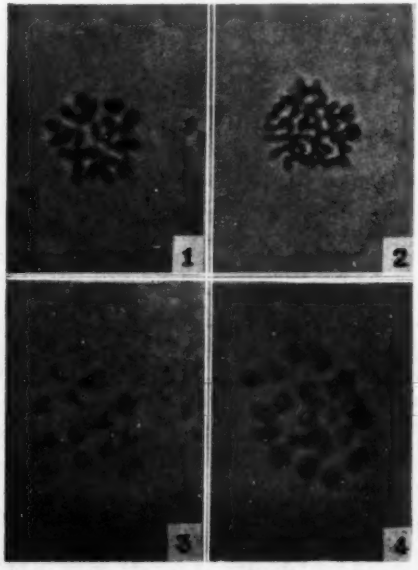
## RAPID CHROMATIN STAINING OF *COFFEA* SP. WITH BASIC FUCHSIN

STAINING with leuco basic fuchsin (Shiff reagent)[1-2,4-7] is followed invariably after fixation and hydrolysis for varying periods depending on the material and the fixative used and in our experience of repeated trials with *Coffea* sp. the feulgen technique gave weak nuclear reactions and even with modifications involving mordents[1,3] desired staining was not achieved. This necessitated further modifications in the use of basic fuchsin. The use of fixative was completely eliminated and the material directly hydrolysed in N.HCl and then stained with basic fuchsin. This gave brilliant magenta staining of chromosomes in shoot-tips, root-tips, anthers and endosperm of *Coffea canephora* Pierre. and *Coffea arabica* L. (Figs. 1-4). The modified technique was also tried and successful results obtained with *Alamanda cathartica* L., *Allium cepa* L., *Gloriosa superba* L. and *Naravelia zeylanica* D.C.




FIGS. 1–4. Fig. 1. Somatic metaphase chromosomes in a cell in the shoot-tip of *Coffea canephora* Pierre. Fig. 2. Somatic metaphase chromosomes in a cell in the shoot-tip of *Coffea arabica* L. Fig. 3. Meiotic metaphase chromosomes in a pollen mother cell in *Coffea canephora* Pierre. Fig. 4. Meiotic metaphase chromosomes in a pollen mother cell in *Coffea arabica* L. (Magnification, × 2,250)

The modified staining scheduled with basic fuchsin is given below:

(1) Hydrolysis of small pieces of tissue for 2-5 mts. in cold N.HCl; (2) Transference to distilled water for 1-2 mts. Prolonged washing is avoided; (3) Small pieces of tissue are placed on a slide in a drop of 1% aqueous basic fuchsin. Gentle warming may be given; (4) A small drop of 45% acetic acid is put on the tissue and immediately a coverslip is placed and pressure is applied under folds of blotting-paper. Gentle heating helps in spreading the cells.

Heating and excessive pressure are best avoided in the case of anthers since they burst the pollen mother cells.

The author is indebted to Dr. N. G. Chokkanna, Director of Research I/C and Sri R. L. Narasimhaswamy, Botanist, Coffee Research Station, for their keen interest and encouragement in this work.

Division of Botany, S. VISHVESHWARA.
Coffee Research Station,
Chickmagalur District (S. India),
*December* 24, 1959.

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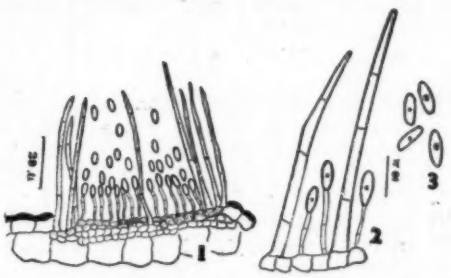
## A NEW SPECIES OF *COLLETOTRICHUM* FROM AN ECONOMIC HOST

DURING the months of August and September 1958 the writer came across many Jasminum plants showing severe blighting of leaves and shoots which on critical examination were found to be infected with a species of *Colletotrichum*. Since there is no record of the above fungus on this economic host it is presented as a new species of *Colletotrichum* with Latin diagnosis.

*Colletotrichum jasminicola* TILAK SP. NOV.

Infectionis maculæ luteolæ vel fusce brunneae, amphigenæ, Acervuli disco similes, epiphylli, subepidermales, typice ornati setis fuscis circa marginem, 140-230 μ. Setæ nonnihil tumescentes ad basin, 2-4-septatæ, magnit. 30-40 μ. Conidiophori breves, simplices, septati, hyalini; conidia ovoidea vel oblonga, hyalina, semel cellulata, magnit. 8-11 × 3-5 μ.

Lectus in foliis viventibus atque culmis Jasmini sambac Ait. ad Poona, in India mensibus augusto et septembri anni 1958 a S. T. Tilak.




FIGS 1-3. *Colletotrichum jasminicola*. Fig. 1, Section through acervulus. Fig. 2. Setæ conidiophore and conidia. Fig. 3. Conidia.

The type specimens have been deposited in Herbarium Cryptogamæ Indiæ Orientalia, New Delhi, and Herbarium of the Commonwealth Mycological Institute, Kew, England.

The author is grateful to Prof. M. N. Kamat for guidance, to Dr. S. P. Agharkar, Director, for laboratory facilities and to Rev. Father H. Santapau for Latin diagnosis.

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Law College Buildings,
Poona-4,
*September* 10, 1959.

## AN INVESTIGATION ON THE REACTION BETWEEN VANADYL SULPHATE AND MALONIC ACID

ZOLOTAVIN AND KALUGINA[1] reported the formation of two complexes between oxalic acid and vanadyl sulphate. The probable structures determined are $[VO(Ox)]^+$ and $[VO(Ox_2)]^\circ$. The results of the reaction between vanadyl sulphate and malonic acid by conductometric method are briefly discussed here.

Aqueous solutions of vanadyl sulphate and malonic acid were employed. Vanadyl sulphate shows a tendency to hydrolysis and hence the solution was rendered slightly acidic. Monovariation method was used to determine the formation of the complex. A break is seen in the curve showing complex formation. The composition of the complex formed was determined by Job's continuous variation method[2] by taking M/10 solution each of vanadyl sulphate and malonic acid. The experiment was repeated with M/20, M/30 and M/40 solutions each of vanadyl sulphate and malonic acid. In all the cases the maxima in the curves between

difference in conductivity and percentage of malonic acid were obtained at 50% of malonic acid, indicating 1 : 1 ratio. This ratio determines the composition of the complex and its formation may be represented by the equation :

$$2\,VOSO_4 + 2\,C_3H_4O_4 \rightarrow 2\,[VOC_3H_2O_4]^+ + 2\,H_2SO_4.$$

That sulphuric acid was one of the products of the reaction was ascertained by the pH data obtained. With the formation of the complex the pH of the solution attained a value of 2·25.

The instability constant of the complex was determined by Job's method for four different concentrations, namely, M/40 solution of vanadyl sulphate with M/20, M/10 solutions of malonic acid, M/20 solution of vanadyl sulphate with M/5 malonic acid and M/10 vanadyl sulphate with M/5 malonic acid. The average value of the instability constant K was $1{\cdot}6 \times 10^{-4}$ at 20° C.

The authors express their grateful thanks to Prof. A. K. Bhattacharya for his keen interest in the work.

Dept. of Chemistry, University of Saugar, Saugar (M.P.), *January* 5, 1960.

P. K. Bhattacharya.
S. N. Banerji.

1. Zolotavin and Kalugina, *Zhur. Neorg. Khim.*, 1950, **1**, 703.
2. Job, *Ann. Chem.*, 1928, **9**, 113.

## *MASONIELLA INDICA* SP. NOV.

During the course of studies on the distribution of microfungi in cultivated, uncultivated and forest soils of Hyderabad (Andhra Pradesh) a species of *Masoniella* (Smith) Smith[1,2] was isolated from the soils of Narsapur forest. The fungus was found to differ sharply from the two species, *Masoniella grisea* and *M. chantarum*, so far described[1,2] and also from *Masoniella* sp. reported by Ghosh.[2] As the phialides are longer and the conidia vary in size and shape, the fungus under study is described as new species.

Coloniæ lente evolutæ in agaro solani tuberosi succroso 2% ad temp. cubiculi, primo pallide brunneæ, post dies vero decem brunneo-griseæ, stromatica serie nigricanti, mycelio æreo velutino ; hyphæ vegetativæ parietibus sat crassis ornatæ, asperæ, fusce brunneæ, sparse septatæ, 2·0–4·5 μ diam. ; hyphæ fertiles hyalinæ vel subhyalinæ, leves, septatæ, 1·5–4·5 μ diam., supportantes phialides irregulariter per totam longitudinem ; phialides hyalinæ, sessiles, non-nunquam pediculis brevibus insidentes, singulæ vel irregulariter binæ quaternæve, tumescentes ad medium, fastigatæ ad apicem angustissimum, 8·5–15·0 × 3·0–4·3 μ. Conidia unicellulata, brunnea, catenulata, ovata vel elliptica, apiculationibus ornata ad unum vel ad utrumque apicem, raro subglobosa, pulchre spinulosa, spinis efformantibus lineas circum conidia, 6·3–9·3 × 2·7–4·65 μ.

*Masoniella indica* sp. nov. Salam (Fig. 1)

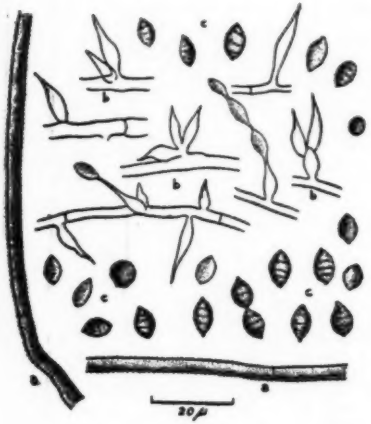



Fig. 1. *Masoniella indica* sp. nov. (*a*) Vegetative hyphæ ; (*b*) Fertile hyphæ bearing the phialides; (*c*) Conidia.

*Masoniella indica* sp. nov. Salam and Ramarao

Colonies of the fungus grow slowly on 2% potato-sucrose agar at room temperature, pale-brown at first, becoming brownish-grey after ten days with a blackish stromatic layer and velvety aerial mycelium ; vegetative hyphæ rather thick-walled, rough, dark-brown, sparsely septate, 2·0–4·5 μ in diameter ; fertile hyphæ hyaline to sub-hyaline, smooth, septate, 1·5–4·5 μ in diameter, bearing the phialides irregularly along the whole length ; phialides hyaline, sessile, sometimes borne on short pedicels, solitary or in irregular groups of two to four, swollen in the middle tapering to a very narrow tip, 8·5–15·0 × 3·0–4·3 μ. Conidia one-celled, brown, borne in chains, ovate to elliptical with apiculations on one or both ends, rarely subglobose, finely spinulose, spines forming bands round the conidia, 6·3–9·3 × 2·7–4·65 μ.

The type culture is being deposited in Indian type culture collection of Fungi, Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi.

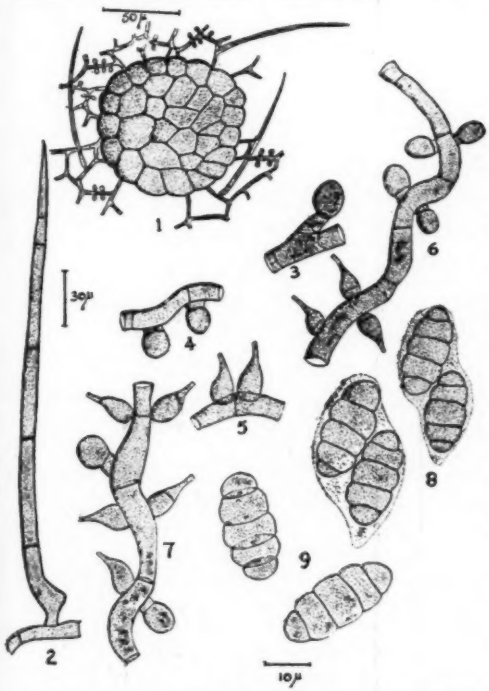
The authors express their thanks to Rev. Father Prof. H. Santapau for the Latin diagnosis of the species.

Dept. of Botany, M. A. SALAM.
Osmania University, P. RAMARAO.
Hyderabad, *February* 6, 1960.

1. Smith, G., *Masonia*, a new genus of Hyphomycetes, *Trans. Brit. Myc. Soc.*, 1952, **35**, 149.
2. —, *Masoniella* nom. nov., *Ibid.*, 1952, **35**, 237.
3. Ghosh, G. R., "Fungi isolated from Cuttack soil," *Proc. 47th Ind. Sci. Congr.*, 1960, Part **3A**(b), 321.

## *MELIOLA ALBIZZIAE* HANSFORD AND DEIGHTON FROM ASSAM

RECENTLY extensive areas of a shade tree, namely *Albizzia odoratissima* Benth. from Cherideo Purbat Tea Estate have been reported to be infected by a sooty mould. The specimens were examined and the leaflets were found to be covered with cleistothecia of a *Meliola*. The fungus under report very closely agrees with *Meliola albizziæ* Hansford and Deighton[1] described from West Africa and is being reported here for the first time from India. A brief description and illustration of the local collection is presented in this note.




FIGS. 1–9. *Meliola albizziæ* Hansford and Deighton. Fig. 1. Cleistothecium showing mycelial seate and hyphopodia. Fig. 2. A mycelial seta. Figs. 3–4. *Hyphopodia capitata*. Fig. 5. *Hyphopodia mucronata*. Figs. 6–7. Showing the arrangement of the hyphopodia. Fig. 8. Asci with spores. Fig. 9. Ascospores.

Plagules epiphyllous, thin to dense, more often confluent than discontinuous. Mycelium dematiaceous, sinuous, repent, measuring up to 8 μ in diameter, composed of individual cells that are up to 30 μ long, ramified, reticulate. *Hyphopodia capitata* are alternate or opposite, attached obliquely to the mycelium, at times erect to sub-erect measuring 10 to 15 μ long, the basal cell short, cylindrical, 3 to 5 μ long, the apical cell cylindrical, clavate with obtuse or subconical apex straight or somewhat curved, measuring up to 10 μ in diameter. *Hyphopodia mucronata* dispersed between *Hyphopodia capitata*, alternate, opposite or indifferent, ampulliform or conoid, measuring up to 15 μ long. Mycelial setæ abundant, scattered, erect, measuring up to 300 μ long by 8 μ broad with rough surface. Perithecia scattered, globose, verrucose, up to 160 μ in diameter. Asci two-spored, ascospores hyaline when not mature turning fuligineous with maturity, cylindrical with obtuse apices, 4-septate, constricted at the septa, measuring 30 to 40 by 12 to 14 μ.

The specimens are deposited in the Mycological Herbarium, Tocklai Experimental Station.

I am grateful to the Director, Tocklai Experimental Station, Indian Tea Association, for permission to publish this note, to Mr. J. L. Lampitt, Scientific Officer, The Assam Company, for kindly bringing the fungus to our notice and to Mr. K. C. Sarmah for his keen interest.

Tocklai Experimental Station, V. AGNIHOTHRUDU.
Indian Tea Association,
Chinnamara (Assam),
*January* 29, 1960.

1. Hansford, C. G. and Deighton, F. C., "West African Meliolineæ II", *Mycological Papers, Commonwealth Mycological Institute*, 1948, **23**.

# REVIEWS

## DOVER BOOKS

**Algebraic Theories.** By Leonard E. Dickson. Pp. ix + 276. Price $ 1.50.

**A Treatise on Algebraic Plane Curves.** By Julian Lowell Coolidge. Pp. xxiv + 513. Price $ 2.45.

**The Theory of Numbers and Diophantine Analysis.** By Robert D. Carmichael. Pp. 94 + 116. Price $ 1.35.

**An Elementary Treatise on Fourier's Series and Spherical, Cylindrical and Ellipsoidal Harmonics with Applications to Problems in Mathematical Physics.** By William Elwood Byerly. Pp. ix + 287. Price $ 1.75.

Dover Publications have added to their list four more reprints of mathematical books which were written by some of the eminent mathematicians of America during the closing years of the Nineteenth Century.

*Algebraic Theories* by Dickson will be a helpful book to students and teachers who desire to get an introduction to topics in higher algebra. The book treats topics in higher algebra such as matrices, linear transformations, quadratic, bilinear and Hermitian forms the Galois theory of algebraic equations, finite linear groups including Klein's 'icosahedron' and algebraic invariants. Elementary divisors and invariant factors are introduced in a simple natural way in connection with the classical form, and a rational canonical form of linear transformations.

*A Treatise on Algebraic Plane Curves* offers a detailed, thorough introduction and background to the theory of algebraic plane curves and their relations to various fields of geometry and analysis. The text treats such topics as the topological properties of curves, the Reimann-Rock theorem, and all aspects of a wide variety of curves, two parameter nets, the Laguerre net, non-linear system of curves, etc. It is almost entirely confined to the properties of the general curve rather than a detailed study of curves of the third or fourth order. Algebraic procedure is generally used, with large portions written according to the spirit and methods of the Italian geometers. However, there is much use of geometric methods, especially those involving the projective geometry of hyperspace.

Two tracts by R. D. Carmichael respectively on the theory of numbers and diophantine analysis have been bound together in the book entitled *The Theory of Numbers and Diophantine Analysis.* Part I of the book dealing with the theory of numbers gives a good introduction to the subject and contains some of the well-known theorems on the subject like the theorems of Fermat and Wilson, etc. Written in a lucid style, the book could be understood by anyone with just a knowledge of high school mathematics. In the second half of the book, the author has gathered some general methods of investigation in the theory of Diophantine analysis which still remains mostly a subject comprising of special problems only. The entire tract is organised around the notion of a multiplicative domain and the exposition is supplemented by 222 exercises.

Fourier's series and spherical harmonics by Byerly consists of eight chapters. Chapter I gives an introduction to the subject. Chapters 2, 3 and 4 deal with Fourier Series, their convergence and the applications that they find in mathematical physics. Chapters 5 and 6 deal with zonal harmonics and spherical harmonics respectively. In Chapter 7, the author gives an introduction to Bessel functions, and the application that they find in physical problems, like the vibration of a membrane. Chapter 8 consists of an exposition of ellipsoidal harmonics.

K. S. V.

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**Proceedings of the Fourth Congress on Theoretical and Applied Mechanics.** (Published by the Indian Society of Theoretical and Applied Mechanics, Indian Institute of Technology, Kharagpur.)

The 29 papers presented in the volume under review deal with different problems in classical as well as non-linear Mechanics and are classified into three groups. The first group is concerned with problems in Elasticity, Plasticity and Rheology (9 papers), the second with Fluid and Solid Mechanics (16 papers) and the third with Statistical Mechanics (4 papers). There are papers representing the purely theoretical and computational as well as experimental and statistical procedures.

While a full review of the volume cannot be attempted without taking the papers individually, we may state however that the 'completely mathematical' papers—which are to be found in all the three parts—involve the solutions of

boundary value problems of the pure as well as mixed types and also employ well-known approximation or computation techniques. A few other papers combine experimental and statistical approaches in the investigations. The papers are all of high standard. The variety of topics and of the methods of analysis is bound to help bridge the gulf between the different orbits in the realm of Mechanics.

It is edifying to note that the Congress on Theoretical and Applied Mechanics (India) has become an annual feature. It necessarily brings in its wake more than a mere sporadic activity in research in one important field of knowledge, so vital to our scientific and industrial progress.

S. K. LAKSHMANA RAO.

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**Advances in Inorganic Chemistry and Radiochemistry.** Edited by H. J. Emeleus and A. G. Sharpe, Vol. I. (Academic Press, New York and London), 1959. Pp. xi + 449. Price $ 12.00.

During the past two decades, with the advent of Nuclear Age, there has been a marked resurgence of interest in inorganic chemistry all over the industrial world. The subject has grown in so many ways that it is difficult to define what exactly constitutes inorganic chemistry. The impact of quantum mechanics and the application of physical methods of attack on structural problems have greatly contributed to their rapid growth in this field as such the frontiers of inorganic chemistry have moved a long way in the last two decades and they are moving even more rapidly today. It is difficult to catch up with their progress even for an expert in one branch. *Advances in Inorganic Chemistry and Radiochemistry*, Vol. I, provides an excellent review of recent progress made in the field. The following topics have been dealt in the book by a specialist of reputation in the particular branch : (1) Mechanisms of redox reactions of simple chemistry, (2) Compounds of aromatic ring systems and metals ; (3) Recent studies of the boron hydrides ; (4) Lattice energies and their significance in inorganic chemistry ; (5) Graphite intercalation compounds ; (6) The Szilard-Chalmers reaction in solids ; (7) Activation analysis ; (8) The phosphonitrilic halides and their derivatives and (9) The sulphuric acid solvent system.

In spite of the fact that there is bound to be variation in style and presentation as the book is not written by a single author, each review highlights the current interesting development achieved recently. This collection bears an exemplary international character as the contributors are drawn from all the countries. The editors are to be congratulated for their grand success in their endeavour in catering the needs of both research workers and the non-specialists. The present publication is the first in the series, and we eagerly look forward to the early appearance of subsequent volumes. A. R. V.

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**Processed Plant Protein Foodstuffs.** Edited by Aaron M. Altschul. (Academic Press Inc., Publishers, New York), 1958. Pp. viii + 955. Price $ 26.00.

Cereals and legumes contribute important dietary sources of proteins in many areas of the world, particularly where animal proteins are in short supply or are not taken for socio-religious or economic reasons. Even in the United States, where there is no dearth of animal proteins, it is reckoned that 30% of dietary proteins is from cereals and legumes. The trend that exists for an increasing demand for animal protein foods will also imply greater need for prepared and processed plant protein-rich animal feeds. Improvements in animal feeding practices will again call for more plant protein products. There is also the prodigious pressure both of an increasing world population and of a basic change in man's diet in the direction of making it richer in good protein foods. The present-day realization that suitable blends of vegetable protein dietaries with or without fortification of amino-acids could compare nutritionally with animal proteins has also contributed to methods for development and utilization of plant protein resources especially in the combating of protein malnutrition which is widespread in many regions of the world and which in turn has aroused a tremendous interest in the potential use of vegetable proteins for immediate rehabilitation and nutritional improvement.

For these and other reasons including the wide variety of industrial uses to which plant proteins can be put, the subject-matter of this book is topical.

The book is divided into two parts. The first one consisting of 12 chapters deals with the general properties of plant proteins and their utilization. Important subjects dealt with relate to processing of oilseeds, effects of heat and other processing factors on plant proteins, vegetable protein isolates and their potential uses in foodstuffs, supplementation with amino-acids and evaluation of protein quality. The second part has 20 chapters dealing with processed

plant proteins from individual sources. These include all commercially produced oilseed meals, edible as well as inedible, and many of the tree-nut meals. There are chapters devoted to alfalfa and other leafy meals, peas and beans, fermentation feedstuffs, milling feeds, microbial proteins, algæ, plant residues and pomaces. The last chapter gives data on amino-acid composition of selected foodstuffs. An attempt is made to summarize information on the distribution of animal and vegetable proteins in the national diets of different countries.

This work is an ambitious approach to provide a wealth of information of value to the grower, producer and the user of plant proteins as well as to the investigator on the subject. A certain amount of overlapping is perhaps inevitable, but this makes each individual treatment more or less complete and therefore offers convenience to the reader. The team of 38 authors who have collaborated in this effort has given a thorough account in critically representing most if not all available literature on the subject of plant proteins. The book should serve as a useful reference manual to every one interested.

A. S.

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**Recent Progress in the Endocrinology of Reproduction.** Edited by Charles W. Lloyd. (Academic Press Inc., New York; India: Asia Publishing House, Bombay-1), 1959. Pp. xi + 632. Price $ 12.00.

The process of reproduction, especially in higher animals like mammals, is characterised by the intricacy of the physiological interactions and their governing factors. The unravelling of these has been a challenging problem for biologists, clinicians and physiologists. With the discovery of sex hormones, the study of the physiology of reproduction had a new orientation, with emphasis on endocrinology of reproduction. In 1937, when the exploration of the steroid molecules constituting the sex hormones had been well in progress for a few years, the first International Conference on the Physiology of Reproduction, the Singer-Polignac Colloquim was held in Paris. The twenty years that have passed, since this Conference, witnessed an explosive progress in the endocrinology of reproduction.

To bring out the highlights of this progress and to emphasise the new horizons, and also to provide a stimulating exchange of ideas among active investigations in the different branches of the subject, a Conference was held in 1958 in Syracuse, New York.

The publication under review is the record of the twenty-three papers read at the Conference and the discussions that followed. The programme of the Conference covered a wide range of subjects arranged in the order of sequence of physiological events, from ovulation through fertilisation, implantation and pregnancy to parturition, and finally to lactation. The majority of the papers deal with the recent progress in the well-established problems in the endocrinology of reproduction. Four of the papers, however, deal with a new branch of the subject, *viz.*, neuro-endocrinology. Experimental evidence is presented to show that in hypothalamic events we may find a specific explanation for many of the ill-defined endocrinal reactions. Hypothalamic—endocrine relationships with a feed-back mechanism seem to be of basic significance, at least in some of the events of reproduction.

To Dr. Lloyd is due the credit for the initiative in calling the Conference and for ably editing the proceedings. The book under review presents sufficient evidence to show that the Conference has achieved the object for which it was called. The format of the book maintains the usual high standard of the publications of the Academic Press.

R. V. SESHAIYA.

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**Hormones and Atherosclerosis.** Edited by Gregory Pincus. (Academic Press Inc., New York; India: Asia Publishing House, Bombay-1), 1959. Pp. xvi + 484. Price. $ 13.50.

This book contains 32 articles written by experts and active research workers in the field of 'Hormones and atherosclerosis', which formed part of the Proceedings of a Conference held in Brighton, Utah, America, in March 1958. Dr. Gregory Pincus of the Worcester Foundation for Experimental Biology, Shrewsbury, Massachusetts, deserves the thanks of all concerned for getting the material together and bringing it to the notice of the large school of non-American investigators who are at present engaged in experimental studies in the increasingly important and interesting subject of atherosclerosis and the probable influence of hormones on this process.

The first eight articles and some others coming later in the book relate to the problem of cholesterol metabolism in its various aspects including the nature of cholesterol biosynthesis, the hormonal influences thereon and certain considerations of cholesterol catabolism. A masterly presentation of the known knowledge

regarding biosynthesis of cholesterol by Konrad Bloch is followed by interesting articles on the part played by Mevalonic acid, $C^{14}$-acetate, etc., in the biosynthesis and turnover of cholesterol in Euthyroid and Hypothyroid dogs and under the influence of thyroid hormones and Methyltestosterone. The discussions that followed the presentation of the above observations have also been faithfully recorded and edited under each article so that the reader is able to make a critical study of this complex field and get a proper orientation of the interrelationship between hypercholesterolemia and the various hormones. In a second series of articles, the role of hormones in lipogenesis and lipid transport, particularly in relation to atheromatous lesions and experimental stress is discussed. This is followed by a group of papers dealing with experimental atherosclerosis and the influence of various hormones on this process. The paper on experimental atherosclerosis in dogs by Marmorston in his section is particularly worthy of note as here a very fine demonstration of coronary and cerebral artery involvement in induced atherosclerosis has been made. Another set of papers reviews the available data on the influence of various hormones on experimental atherosclerosis and the interrelationship between blood lipids and the endocrine state in animals and man. Some papers also deal with the clinico-biological correlation of endocrine influences on human atherosclerosis.

The coverage of such a wide range of investigations in a single treatise will naturally be welcomed by all investigators. It not only presents fundamental data and concepts but also methodology and technique of assessment of experimental and human atherosclerosis including its most important complication of coronary occlusion. Not all of the endocrine influences on atherosclerosis discussed here are clear cut and vividly definable but the data show the lacunæ in our knowledge well and pose pertinent investigative approaches to the still unsolved problems. The important question of hormone treatment of human atherosclerotic diseases has not yet been answered but the orientation given will help canalise clinical and laboratory work in more detail. As a research contribution in a complex field of study, the book is expected to create a great deal of interest and attention.

B. MUKERJI.

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**General Cytochemical Methods.** Vol. I. Edited by J. F. Danielli. (Academic Press; India: Asia Publishing House, Bombay), 1958. Pp. 470. Price $ 12.80.

Cytochemistry has come to be accepted as a recognized discipline for the demonstration and measurement of intracellular substances. Since 1950, enough has been done to warrant the publication of standard methods for a number of them. The early history of this discipline, like that of any other, had its controversies, but over the years, it has been possible to standardize most of the techniques. Some years ago, the International Society for Cell Biology set up a Cytochemical Commission whose labours have been directed to the publication of these standardized techniques. The volume under review is the first of a series and if it is an indication of what is to follow, then we can safely expect a most useful series indeed.

Nine articles contributed by experts in their respective fields are included here. Engstrom and Lindstrom's article deals with the relatively new field of the employment of soft X-rays (wavelength, 5 Å–10 Å) for the analysis of submicroscopic particles in the cell. The Karolinska Institute in Stockholm where the authors work, has pioneered the development of physical and specially optical techniques for biological research and this is one of the newer applications of these techniques. The interference microscope is only slightly older and the quantitative estimation of substances is fully dealt with by Davies who is among the first to develop the microscope for quantitative work. Walker's article on U.V. spectrophotometry sets out the theoretical considerations of the method while the results of its application to biological material, especially for DNA determinations, has been dealt with in an article by Leuchtenberger who, during the past 10 years, has examined a great variety of material. Pelc summarizes our knowledge of the principles and applications of autoradiography. Bennet and Watts describe the methods of determination and measurement of sulfhydryl groups based largely on their own experience with mercury orange. Holt deals with the demonstration of esterases while Danielli describes the possibility of using the cytochemical methods for the demonstration of alkaline phosphatase for quantitative determinations. Coons describes the recent methods developed for the location of antigens by the employment of the fluorescence microscope.

In every one of the papers presented in this volume, the emphasis has been on the utilization of the technique for quantitative determinations. These have necessarily involved the application of physical and chemical laws. Like other techniques, they should be expected to undergo modification and refinement. But that they have contributed to the elevation of Biology from a purely descriptive to a highly deductive science, there is hardly any doubt.

B. R. S.

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**The Biology of the Amoeba.** (*Annals of New York Academy of Sciences.* Vol. 78), 1959. Pp. 401-704. Price $ 4.50.

The Amœba first described by Rösal von Rosonhof in 1755 as der kline Proteus remained till recently a class-room material. It is only during the past decade that its potentialities as an experimental animal has been recognised.

This monograph, giving the highlights of a conference, attempts to summarize the variety of investigations carried out on these organisms. The papers embrace: (1) Structural and Taxonomic Considerations; (2) Physical Studies and Cell Division; (3) Cytochemistry and Enzymes and (4) Nuclear Cytoplasmic Relationships. An unusual feature is an article by Kopac on "Research on Amœba in 2158 A.D." The volume, therefore, is a good source of reference to current investigations on these organisms.

It is fittingly dedicated to the memory of Prof. Robert Chamber who pioneered micrurgical investigations on Amœba.

M. K. S.

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**Studies on the Structure and Development of Vertebrates.** Vols. I-II. Second Edition. By Edwin S. Goodrich. (Dover Publications, Inc., New York), 1958. Price $ 2.50 each volume.

We welcome the Dover reprint of the *Structure and Development*, first published in 1930. It is now issued in two volumes; the first comprising chapters 1-8 and the second, chapters 9-14. A warm and appreciative biography of the late F. S. Goodrich by Sir A. Hardy is also included, originally published in the *Quarterly Journal of Microscopical Science.* The volumes offer a mine of information on vertebrate morphology and development and inspiration for future investigations. Comparative morphology of vertebrates can be taught only against a background of evolution of the organ systems and the object is fully achieved in this masterpiece. In Indian Universities where animal morphology occupies the pride of place, this reprint of Goodrich's book in the present cheap edition will be gratefully appreciated.

L. S. R.

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**The Human Itegument : Normal and Abnormal.** Publication No. 54. (American Association for the Advancement of Science, Washington, D.C.), 1959. Pp. x + 260. Price $ 5.75.

*Proceedings of a Symposium organised by American Association for Advancement of Science.* Edited by Stephen Rothman.

This Symposium co-sponsored by the American Medical Association's Committee on cosmetics and the Society for investigative dermatology presents the advances in the field of cutaneous physiology and their application to clinical dermatology.

Dermatological therapy is coming out of an era of empiricism to one of rational basis. The physical, chemical and enzymatic approaches involved in the transfer of matter through the skin and in the protection offered by the integument against the invasion by bacteria and fungi presented in various chapters depict the progress made in this little understood field of dermatology. "The nature of sebaceous secretion and its significance in the maintenance of general health" is a very interesting feature of these investigations.

The brief review on etiological factors and the pathogenesis of *Acne vulgaris* and certain epidermal malignant lesions, though not comprehensive, is sufficiently informative. Clinicians will find in the discussions recorded, many new trends of thought on the interrelationship of nutrition to the manifestation of skin lesions.

M. Sirsi.

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**The Harvey Lectures—1957-58.** (Academic Press, New York-3, N.Y.), 1959. Pp. xiv + 254. Price $ 7.50.

*The Harvey Lectures*—53rd of the series for 1957-58—contains 9 articles on various topics, *viz.*, epidemiological studies on the illnesses in families, myxomatosis and control of Rabbits in Australia, tobacco mosaic virus, bacterial reproduction, synthesis of DNA, reactions of lymphoid tissues to antigens (of immediate interest, regarding the hypothesis put forward by Sir Burnet with reference to anti-body production), cell division, study of disease of the lung, and extra-corporal maintenance of cardio-

respiratory functions. Of these, attention may be drawn to the epidemiological study of disease-incidence in families, (a method which has been in vogue in some Western countries, *e.g.*, West Germany, in recent times) specially with reference to hyperpiesis, blood diseases, diabetes, etc., a method which can be adopted by the research-minded-rural-general-medical practitioner, in our country. A good deal of information can be gathered by this inexpensive but long-term study, wherein correct notes are kept of families showing genetic and/or other diseased conditions. As each one of these articles is a detailed study, it can only be stated in general, that they are worth perusal by students engaged in similar studies. Particular attention is also drawn to (1) Bacterial Reproduction by J. Lederburg and (2) Cell Division by Daniel Mazia. These two articles are worthy of careful study.

A review of each article would entail great space; the lecturers have presented subjects in quite a critical manner; students interested are requested to study the original articles themselves. Copies of the Harveyan Lectures are now available in the better libraries in India.

C. V. NATARAJAN.

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The Vanaspati Industry. A Monograph by Dr. Gopal S. Hattiangadi. (Published by the Indian Central Oil Seeds Committee, "Gandhi Bhavan", Hyderabad-1 Dn.), 1958. Pp. 100.

This monograph deals with various aspects concerning the manufacture and marketing of the well-known product "Vanaspati" made in India by the hydrogenation of vegetable oils. Starting with a brief account of the position regarding production and availability of vegetable oilseeds and oils, the author has dwelt on the development of the Vanaspati Industry in India, and explained the theoretical principles underlying hydrogenation and the factors influencing the same in the earlier chapters.

The most important chapter is Chapter III dealing with the manufacturing processes, and machinery required for manufacture of Vanaspati. Subsequent pages deal with production control, factory administration, layout, nutritive value of Vanaspati and marketing data regarding same. Chapter VIII deserves special mention as it discusses recent researches and lines of future development. There is a good bibliography at the end followed by appendices giving specifications and Government rules pertaining to Vanaspati.

Dr. G. S. Hattiangadi deserves to be congratulated on the manner in which he has accomplished a difficult task, and in including such a lot of information within a mere 100 pages.

The get-up and presentation are of the same high order as other publications by the Indian Central Oilseeds Committee.

S. A. SALETORE.

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**The Vertebrate Story.** By A. S. Romer. Fourth Edition of "*Man and the Vertebrates*". (The University of Chicago Press, Chicago-37; Cambridge University Press, London N.W. 1), 1959. Pp. 437. Price 52 *sh.* 6 *d.*

For centuries, biologists and laymen have both been interested in the sequence of events which led to the origin of Man. This interest took definite shape with the coming of Darwin and since then many books have been written on the subject. Regardless of this, Romer has taken it upon himself to write this revised version of his famous book "*Man and the Vertebrates*", the last edition of which appeared in 1941.

Romer himself speaks of this revision as a "radical one". Among the more important differences between the older editions and this are the omission of the entire section on the human body and the inclusion instead, of a variety of topics of interest in connection with the Vertebrate story. The lower groups of vertebrates are dealt with in greater detail, the chapter on the frog remaining practically unchanged. In the chapter on Human Origins, the problem of the Piltdown Man has been overcome inasmuch as it is exposed as a hoax. Recent topics of current interest have been added.

The most interesting feature of Romer's book is that while it is scientific and meant mainly for students of biology, it can be read with lively interest by the layman. His form of presentation is easy and almost genial and one cannot help but feel that one would like to have more of this author.

Eighty new photographs have been added to make in all 122 plates each of which is a work of art. Besides these, there are numerous text drawings. In the appendices the author provides a synoptic classification of chordates and a useful bibliography.

The book is beautifully produced and makes very good reading.

B. R. S.

**Dechema Monographs**

The report on the European Convention of Chemical Engineering 1958 held in Frankfurt (Main), in so far as it concerns the lectures delivered at the II Congress of the European Federation of Chemical Engineering and the Achema Congress 1958, has now been published in the form of 7 volumes of the Dechema Monographs. The volumes deal with the following main branches of chemical engineering: Volume 30—*Nuclear Science and Technology* (260 pages); Volume 31—*Laboratory Techniques* (297 pages); Volume 32—*Works Techniques: General Principles* (412 pages); Volume 33—*Works Techniques: Processes and Operations* (317 pages); Volume 34—*Works Techniques: Processes and Rationalization* (356 pages); Volume 35—*Measurement and Control Techniques* (336 pages); Volume 36—*Structural Materials Techniques* (280 pages).

The lectures are written in the German language and summaries in English and French are included. A study of these volumes will be of great service to every chemist, engineer and physicist.

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Books Received

*Electrolytic Conductance.* By R. M. Fuoss and F. Accascina. (Interscience Publishers, New York), 1959. Pp. ix + 272. Price $ 8.00.

*Semi Conductors.* By R. A. Smith. (Cambridge University Press, London N.W. 1), 1959. Pp. xvii + 494. Price 65 *sh.*

*Organic Chemistry.* By D. J. Cram and G. S. Hammond. (McGraw-Hill Book Company, New York-36, N.Y.), 1959. Pp. xv + 712. Price $ 8.50.

*Chemotherapy of Animal Trypanosomiasis.* By S. K. Sen. (Indian Council of Agricultural Research, New Delhi), 1959. Pp. 210. Price Rs. 9·50.

*Electrophoresis—Theory, Methods and Applications.* Edited by Milan Bier. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1959. Pp. xx + 563. Price $ 15.00.

*Analytical Elements of Mechanics,* Vol. I. By T. R. Kane. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1959. Pp. xv + 250. Price $ 4.75.

*A Text-Book of General Physiology.* Second Edition. By H. Davson. J. and A. Churchill, Ltd., London W. 1), 1959. Pp. xvi + 846. Price 84 *sh.*

*Acoustics for Music Students.* By C. Subrahmanya Ayyar. (Published by the author, 46, Edward Elliots Road, Madras-4), 1959. Pp. 71. Price Rs. 1·50.

*Chemical Analysis of Resin-Based Coating Materials.* Edited by C. P. A. Kappelmeier. (Interscience Publishers, New York), 1959. Pp. xxvii + 630. Price $ 19.50.

*Darwin's Biological Work—Some Aspects Reconsidered.* Edited by P. R. Bell. (Cambridge University Press, London N.W. 1), 1959. Pp. xiii + 342. Price 40 *sh.*

*Human Biochemical Genetics.* By H. Harris. (Cambridge University Press, London N.W. 1), 1959. Pp. viii + 310. Price 37 *sh.* 6 *d.*

*Lehrbuch Der Theoretischen Physik.* By Georg Joos. (Akademische Verlags, Gesellschaft M.B.H., Frankfurt Am Main), 1959. Pp. xxiii + 842. Price not given.

*Chemical Analysis,* Vol. 9.—*Analytical Chemistry of Titanium Metals and Compounds.* By M. Codell. (Interscience Publishers, New York), 1959. Pp. xiii + 378. Price $ 12.00.

*Introduction to Colloid Chemisty.* By Karol J. Mysels. (Interscience Publishers, New York), 1959. Pp. xv + 475. Price $ 10.00.

*Radar Meteorology.* By L. J. Battan. (For the University of Chicago Press, Cambridge University Press, London N.W. 1), 1959. Pp. xi + 161. Price 45 *sh.*

*Biochemical Society Symposium—Glutathione.* Edited by E. M. Crook. (Cambridge University Press, London N.W. 1), 1959. Pp. 115. Price 22 *sh.* 6 *d.*

*Progress in Inorganic Chemistry,* Vol. 1. Edited by F. Albert Cotton. (Interscience Publishers, New York), 1959. Pp. ix + 566. Price $ 14.50.

*Photoperiodism in Plants and Animals.* Edited by R. B. Withrow. (American Association for the Advancement of Science, 1515 Massachusetts Avenue, Washington-5 D.C.), 1959. Pp. xvii + 903. Price $ 14.75.

*A Guide to Antibiotic Therapy.* By Henry Welch. (Medical Encyclopedia, New York), 1959. Pp. 69. Price $ 3.00.

*Antibiotics Monographs—12—Antibiotic Therapy for Staphylococcal Disease.* Edited by Henry Welch and Maxwell Finland. (Medical Encyclopedia, New York; Outside New York: Interscience Publishers, New York), 1959. Pp. xii + 208. Price $ 4.50.

*Technique of Organic Chemistry,* Vol. I, Part I. Third Edition. *Physical Methods of Organic Chemistry.* Edited by A. Weissberger. (Interscience Publishers, New York), 1959. Pp. xii + 894. Price $ 24.50.

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# SCIENCE NOTES AND NEWS

## Award of Research Degree

Cambridge University has awarded the Ph.D. Degree on Dr. Vishnu Mittre, of the Birbal Sahni Institute of Palæobotany, Lucknow, for his thesis entitled "Post-Glacial Vegetational History of the East Anglian Fenlands".

Messre G. K. B. Navale and B. S. Venkatachala have been awarded the Ph.D. Degree in Botany by the Lucknow University on their theses entitled "Some contributions to Indian Palæobotany" and "Palynological Investigations of Some Upper Palæozoic Coals" respectively.

The Annamalai University has awarded the Ph.D. Degree in Chemistry to Sri. T. Rangarajan for his thesis entitled "Activating Influence of the Sulphonyl Group and Steric Effect in Sulphones".

Karnatak University, Dharwar, has awarded the Ph.D. Degree in Physics to Messrs. K. S. Raghavendra Rao and D. R. Bagalkoti for their theses entitled "Studies in Active Nitrogen" and "Studies of Krypton effect on some Nitrogen Band Systems" respectively.

## Karrer Symposium on Vitamin A

The Karrer Symposium on Vitamin A, will be held in Burgenstock (near Zurich) in Switzerland during May 23 to 26, 1960. Among those who have been invited to participate in the symposium is Dr. J. Ganguly of the Department of Biochemistry, Indian Institute of Science, Bangalore.

## First Congress of the Asia-Pacific Academy of Ophthalmology

The First Congress of the Asia-Pacific Academy of Ophthalmology will be held in Manila, Philippines, from October 10 to 13, 1960, under the sponsorship of the Philippine Ophthalmological Society. Delegates from different countries of the Asia-Pacific regions and guests from America and Europe will participate in the Congress. Its main theme would be : *Blinding Diseases of the Asia-Pacific Regions.*

The Committee on Scientific Programme has extended the last date to May 31, 1960, for the submission of titles of free papers (with brief abstracts of 200 words) and Medical Films. In addition to these papers and films, there will also be Guest Lectures by prominent ophthalmologists from America, Australia, Europe and India.

For registration or further particulars, kindly communicate with Dr. Jesus V. Tamesis, Executive Chairman, 42 Quezon Blvd., Quezon City, Philippines.

## Research Grants from IAEA for Atom Scientists

Atomic scientists prevented from pursuing promising research because of lack of facilities, equipment or funds in their own countries may receive assistance from the International Atomic Energy Agency in the form of research grants.

The Agency's Exchange Unit is trying to find suitable places for such scientists and will pay their travel expenses as well as salaries of between $ 400 and $ 900 per month. These research grants are intended for scientists with considerable research experience who are already working in their own countries on a promising line of research.

Scientists wishing to secure this kind of assistance must apply to the Agency through their own national authorities and will have to supply, *i.a.*, the following information :

> a description of the research problem on which they are working, of the results so far obtained and of the difficulties encountered in proceeding with their work in their own countries ; proposals as to places where these difficulties could be overcome and the research continued ; an estimate as to the duration of the work to be done away from the home country ; statements concerning the direct importance of their research in relation to their countries' atomic programmes and testimonials confirming this importance as well as the candidate's qualification.—*United Nations Information Centre, 21 Curzon Road, New Delhi.*

## Award to Professor Jean Piccard

At a banquet of the National Conference on Stratospheric Meteorology in Minneapolis, on September 2, 1959, a special award of the

American Meteorological Society was presented to Professor Jean Piccard for his pioneering work in balloon design and technology which has in a large measure provided the basis for modern exploration in understanding of the stratosphere.

In 1934 Professor Piccard (accompanied by Mrs. Piccard) made the record breaking manned balloon flight to 57,579 feet. In 1936 Professor Piccard constructed and flew the world's first cellophane plastic balloon. After World War II, Professor Piccard was principal consultant when the first successful polyethylene balloon was constructed for the Naval Research Project Helios. His design of balloon gondalas for manned stratospheric flights still forms the basis for gondala design in use today.

It may be recalled that his twin brother Auguste Piccard made the first stratospheric flight to 51,793 feet in 1931—*Amer. Met. Soc. Bulletin*, 1960, 41, 38.

### Giant Mirror Telescope Designed

A giant telescope with a mirror diameter of six metres (236 inches) has been designed at the Pulkovo Observatory (near (Leningrad) under the supervision of Dmitry Maksyutov, the well-known designer of astronomical instruments. The world's present largest, the Hale 200-inch, reflecting telescope, has been functioning since 1948 at the Palomar Observatory in the United States.—*USSR News.*

### A New Host of *Dendrophthoefalcata* (L.F.) Ettingsh

Shri Y. S. Murty, Department of Botany, Meerut College, Meerut, writes that recently the flowering parasite *Dendrophthœ falcata* was found firmly established on a tree of *Ficus elastica* growing in the Botanical garden of Meerut College. Now it has come up in flowering, enabling its final identification.

This host is therefore an addition to the list of 268 plants already recorded for this branch parasite.—(Ravindra Nath, V. and Narasimha Rao, V. L., *J. Indian Bot. Soc.*, 1959, 38, 204).

### Magnetohydrodynamic Generator

Recently Westinghouse Research Laboratories demonstrated the first magnetohydrodynamic (MHD) generator to produce electric power from the combustion of a conventional fuel.

The MHD generator produces electric power by passing a super-hot, electrically conducting gas between the poles of a powerful magnet. This ionized gas, the plasma, which substitutes the copper wires in the rotating coils of a standard electric generator, passes down a ceramic-lined tube at 1,800 miles an hour, cuts across the magnetic field of the magnets and gives an electric voltage and current.

The high temperature white-hot air plasma used as the conductor may be obtained from an arc or burner. In the G. E. development a huge electric arc, jumped between two points, heats the air to around 5000° F. The Westinghouse generator on the other hand, burns furnace oil with oxygen at a temperature of about 5000° F. The new method thus shows potentialities for the future development of MHD generator as a large-scale source of electric power.

The demonstration generator, operating at about one-fourth its power rating, has produced 2·5 kilowatts of power and has run continuously for 4 minutes. Previously reported MHD generators have had operating cycles about 5 seconds.—*News from Westinghouse.*

### Standard Frequency and Time Transmission Centre in Delhi

A standard frequency and time transmission centre, ATA, Delhi, has been established at Kalkaji, a suburb of New Delhi. This is the first centre working in South Asia, the nearest ones being situated at Turino, Italy, in the West and Tokyo, Japan, in the East.

The broadcast of time signals is carried out over a standard carrier frequency of 10 Mc./s. (30 metres). The signal consists of second's pulse, minute's pulse, a 1000 c./s. tone, and a code announcement. The second's pulse is a group of five cycles of a 1000 c./s. signal, and the minute's pulse a group of a hundred cycles of a 1000 c./s. signal. The standard tone is broadcast for a period of 4 min. every 15 min. (0-4, 15-19, 30-34 and 45-49 min. every hour). The code announcement, giving the station, call sign and the time in U.T., is transmitted at 20 sec. before the start of the tone. This transmission can be heard during the hours 1100 to 1600 I.S.T. for five days a week—Monday to Friday.

Highly stable piezoelectric quartz crystals are utilised as master oscillators that control standard clocks. Three such crystal standards are mounted on vibration-free concrete pillars, erected inside air-conditioned underground cellars. All the clocks and their associated time control equipments are electronically operated and maintained in continuous operation.

The time signals are correct to a millisecond per day and the frequency is constant to ± 2 parts in 100 million over a nominal value. This high precision is achieved by the continuous comparison of the standards among themselves and by the check-up of the time signals against those received from similar stations established in other countries.—*CSIR News*, 1960, 10, No. 5.

### Study of Radiation Belts by Nuclear Emulsion

Researches are afoot in U.S. to use the nuclear emulsion techniques to obtain more complete measurements of the Van Allen Radiation Belts surrounding the earth. The project known as the Nuclear Emulsion Recovery Vehicle (NERV), is to send a probe vehicle to an altitude of about 1,800 miles and recover it on its impact back to the earth.

The cone-shaped payload will be 19" in diameter, 18" long and weigh 79 pounds. The essential part of the NERV experiment will be a cylindrical disc 3" in diameter and ½" thick, comprised of strips of radiation sensitive material, namely, nuclear emulsion made by Ilford, Ltd. During flight the disc will be exposed to the radiation field. Exposure will be accomplished by means of an electrically operated mechanical shutter which will open at an altitude of about 200 miles, remain open to a height of 1800 miles, and close when the vehicle has dropped to about 200 miles. During exposure the disc will rotate behind a port in a shielded container.

Analysis of the emulsion tracks made by radiation particles will furnish data for identification of the particles and the intensities of radiation at different altitudes and latitudes.

The NERV payload will be buoyant and will be equipped with a recovery system consisting of silverized parachute, electronic search beacons, flashing lights, radar chaff and a dye marker. The parachute will open at about 40,000 ft. to slow the vehicle for impact. In initial flights the impact will be about 2,000 miles from launching site. Ships and planes will assist in the recovery operations. An ablative material will be used to protect the vehicle from the heat generated during re-entry.—*J. Frank. Inst.*, 1960, 269, 76.

### New Facts on Solar X-Rays

Data collected from the Sunflare II experiments conducted by the U.S. Naval Research Laboratory for the International Geophysical Co-operation 1959, have revealed new facts about X-ray emission from the sun reaching high altitudes of the earth's atmosphere.

In the most active phases of solar flares X-rays with energies as high as 80,000 volts were detected above the absorbing atmosphere of the earth. These findings indicate that temperatures in the solar atmosphere may be as high as $10^{8\cdot}$ C.

In the project Sunflare II (1959), the NRL used 12 rockets with instrumentation payloads of about 55 lb. 8 of the 12 rockets were completely successful and attained altitudes between 130 and 150 miles. Approximately 8 minutes of flight data were continuously telemetred during the best flights. Three of these rockets were launched during flares and five during solar quiescence and minor activity.

Previous measurements from Solar flare studies, Project Rockoon (1956) and Sunflare I (1958), indicated that there was a background of X-rays at high altitudes with energies perhaps as high as 50,000 volts. The results of Sunflare II show that such X-rays are a normal solar emission. It appears that even the quiet sun emits a broad spectrum of X-rays extending to very high energies but that the flux is very low. The intense excitation that accompanies a solar flare enhances the X-ray emission over the entire spectral range.—*J. Frank. Inst.*, 1960, 269, 78.

### Oriented Graphite

*Pyrographite* with a highly oriented crystal structure is being produced in commercial quantities by a process in which material is deposited on a substrate from a carboniferous gas, with controlled crystal orientation. The material exhibits remarkable anistropy in both thermal and electrical conductivity, higher by several orders of magnitude, in a plane parallel to the surface than in a plane at right angles to it. In fact the material has a heat conductivity higher than copper in the preferred direction and lower than unoriented graphite in the normal direction. A significant property of the material is its high density. Ordinary commercial graphites have densities ranging from 1·6 to 1·7, and densified graphites up to 2·0. Pyrographite has been prepared with a measured density of 2·22. Density increases with temperature of preparation, due to a higher degree of crystallite orientation. Above 2000° C., where the normal graphite has one of the highest strength-to-weight ratios known, pyrographite has a ratio 5 times as great. It is impermeable

to gases, retaining the property after being heated to 2500° C. and recooled, even in films as thin as 1 to 2 mils. It is believed that these unusual properties will make this material suitable for applications where strength, impermeability and chemical inertness are required at high temperatures.—*Raytheon, Massachusetts.*

**Meteor Trails as Reflectors of Radio Waves**

Research scientists of the U.S. National Bureau of Standards have developed an experimental system in which radio signals have been bounced off 15-miles-long trails of electrons and ionised atoms left by meteors as they enter the earth's atmosphere.

Millions of such meteors enter the atmosphere every day, and it is estimated that several a minute would be available for use between any two stations on the earth's surface. The method promises a world-wide communications system to be developed employing meteor trails as reflectors of radio waves.

Because the system is necessarily intermittent, messages are first recorded on a magnetic tape. Then, when a suitable meteor trail is available the message is transmitted at speeds up to 4,800 words a minute and recorded at a receiving station.

When the system is in use, a station sends out a continuous probing signal to seek out meteor trails. When the signal strikes one, it sets the automatic transmitter to sending the recorded messages.—*Atoms for Peace Digest, January* 26, 1960.

**Technetium**

Technetium is one of the radioactive elements which results from the fission of the uranium atoms in the fuel elements of nuclear reactors and is freed from the spent fuel elements when they are processed for the recovery of plutonium and uranium.

The element has not yet been found in nature and will probably remain undetectable because only infinitesimal quantities are produced in uranium ores. It was first produced in 1937 at the University of California by bombarding molybdenum with neutrons.

Until recently, gram quantities were available from the United States Atomic Energy Commission. But recently the United Kingdom Atomic Energy Authority's Windscale works have produced some twenty grams of technetium in the pure state. For this, over one hundred tons of waste fission products had to be processed.

An ion exchange resin was used for the initial separation of the element which was then removed from the resin with strong nitric acid and concentrated by evaporation. Further purification and concentration was afforded by extraction into the solvent methylethyl ketone which was finally removed by evaporation.—*ISLO Science Newsletter.*

**Ultra-violet Radiometry Standard**

The U.S. National Bureau of Standards has developed a Blackbody which shows potentialities as a standard of ultra-violet radiation. New materials for use at high temperatures have been used in constructing this blackbody. The special graphite cylindrical enclosure is 4½" long and 1½" in diameter with walls 3/16" thick. The exit end of the tube has a ⅜" opening shielded by a conical graphite end-piece ¾" long, which contains a second similar opening.

The blackbody is heated by an induction method in a 6-turn water-cooled coil, powered at 450 kc. by an r-f generator. The graphite tube is insulated by tightly packed boron powder in a high-temperature porcelain container. An alandum ceramic tube between the graphite core and the porcelain container increases physical stability. By enclosing this furnace in an air-tight helium-filled chamber, oxidation of the graphite at high temperatures is considerably reduced.

In comparing the radiation of this graphite enclosure at temperatures near 2000 K with calculations based on Planck's law, it was found that the radiation output closely approximates that of an ideal blackbody. Calculations based on physical characteristics of the graphite tube support this conclusion.—*Electronics, February* 16, 1960.

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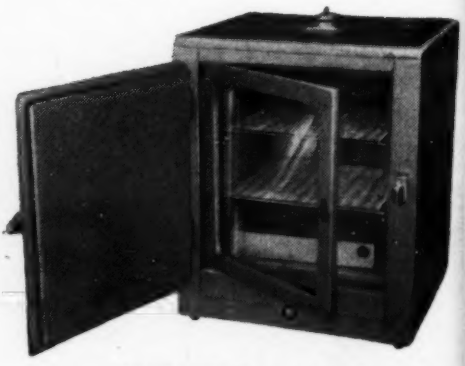

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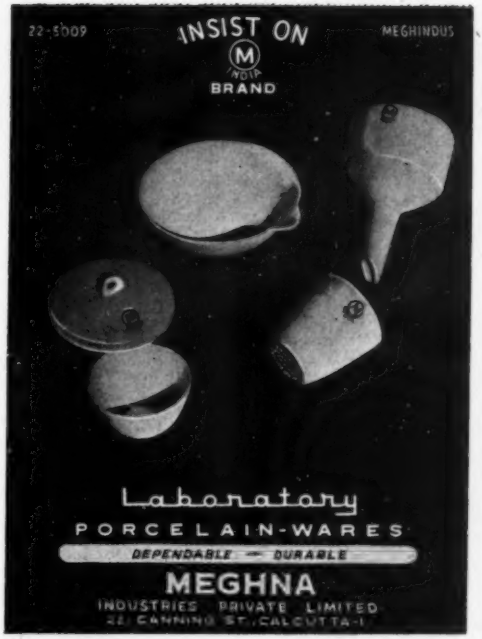


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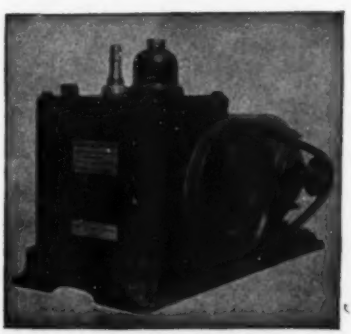

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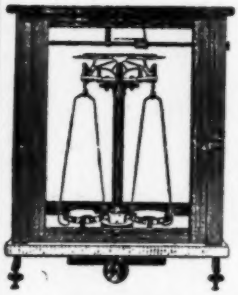

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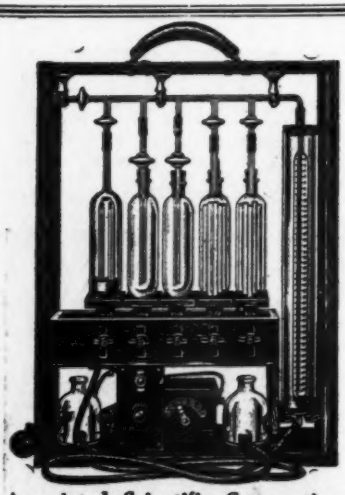

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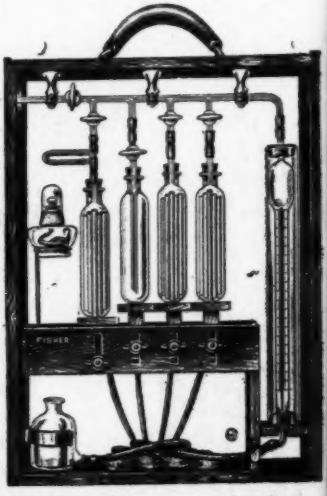

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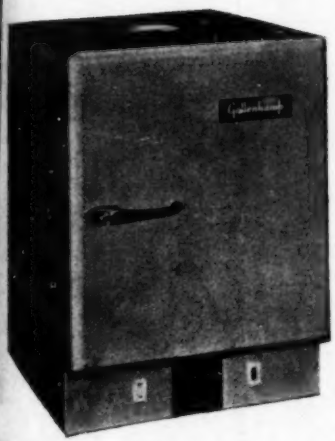

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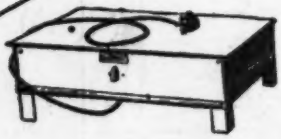

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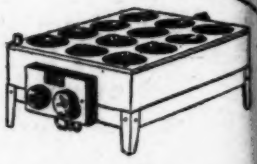

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